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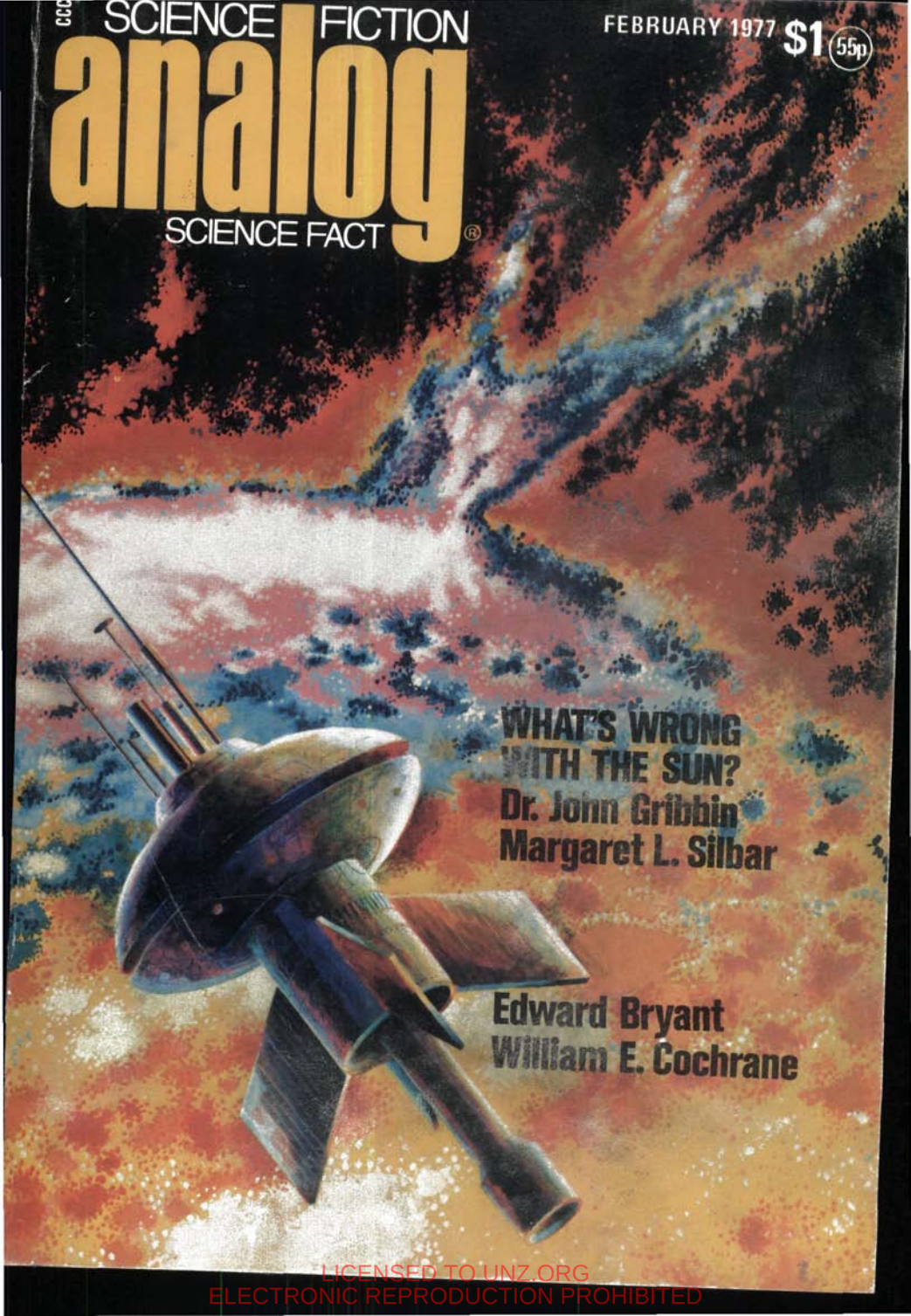

WHAT'S WRONG WITH THE SUN?
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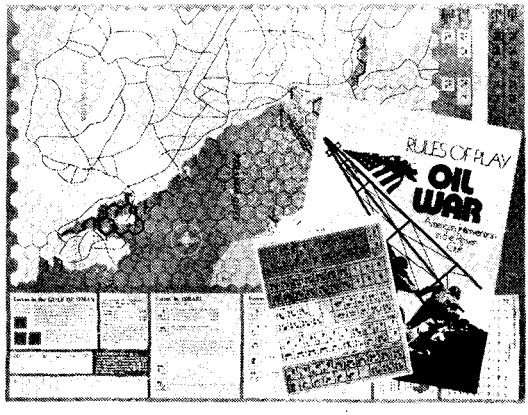


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# good news, bad news

As they say in the joke, I have good news and bad news.

The bad news first.

The cover price of Analog will go up to $1.25 starting with our April issue. And, starting in *this* issue, the Analytical Laboratory will be dropped as a regular feature.

Now the good news.

We have increased the rates we pay for fiction to a new top rate of six cents per word for stories up to 7500 words long, and four cents per word for longer stories. Our previous rates were 5¢/3¢. Also, in place of the AnLab, we now have a new feature, photobiographies of Analog's contributing writers and illustrators.

To explain:

The Condé Nast Publications, Inc., has held the cover price of Analog to $1 since our March 1975 issue, despite a steadily growing inflation and constantly spiraling prices for postage, ink, paper, and practically all the other goods and services connected with producing the magazine. The back-breaking blow fell in October, when our paper costs took a quantum jump. Despite our best efforts to keep the price of the magazine stable, there is no way we can pay our rising costs and still make a profit, unless we increase the price.

And there is no way to continue to publish a magazine if it does not make a profit. Analog has traditionally been a profitable magazine, even though the profit has traditionally been quite slim. As John Campbell used to say, "Analog is a gold mine . . . but it's only a teeny little gold mine."

Condé Nast will maintain the subscription rate at $9 for twelve issues through June. So if you want to stave off the price increase, subscribe now. The one-year subscription price will go up to $10 after June.

I can remember when science fiction magazines cost a quarter, and many readers can remember even lower prices. But in those days, phone calls and cups of coffee were a nickel, hardbound books cost about two dollars, and paperbacks were only a quarter. Today, paperbacks sell for $1.50 and up, and if you can



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find a hardbound book for less than $5 you have better eyes than mine. Even book-club offerings range from $1.98 to $10 and more.

At the $1.25 cover price, Analog will still be less expensive than paperbook books, less expensive than a typical cafeteria sandwich, and a lot more nourishing than either.

The decision to end the Analytical Laboratory was not made lightly, either. After all, the AnLab has been a regular feature of this magazine for longer than most of our readers have been alive. But the time has come to recognize that the AnLab's usefulness is at an end. Ask yourself when was the last time *you* sent in an Analytical Laboratory vote.

The idea behind the AnLab was two-fold: First, to get the readers' ratings of the stories in each issue, an invaluable aid to the Editor. Second, to translate those readers' preferences into bonus money for the authors of the best-liked stories.

That was a fine and noble aim, and it still is. The trouble is that most of the readers do not bother to vote. And by most, I mean almost everybody! It's been a long, long time since we received as many as one hundred votes.

From time to time during the past five years we have urged readers to send in their ratings of the stories. We've published the rules of Analytical Laboratory as often as space permitted, so that the readers could understand how the voting worked and what its significance was. After each remonstration we got a brief flurry of increased interest, but the voting always settled down quickly to the few "regulars" who sent in their cards and letters every month.

It's just not fair to reward some authors and neglect others on the basis of a miniscule number of votes. Inevitably, the longest story of each issue won the first-place vote, and the extra penny a word bonus that went with it. With almost equal regularity the next-longest story took second place and the half-cent bonus. Short stories were hardly ever in the money; even short stories that eventually won Hugo and Nebula nominations and awards.

This is not to denigrate the faithful few who have taken the time and trouble to vote regularly in the AnLab poll. I hope that they continue to let me know which stories they prefer . . . and why.

The first function of the AnLab, that of apprising the Editor of the readers' preferences, is being done to a large extent by the droves of letters we receive each week. Analog's audience has always been vocal, as well as loyal, and I receive plenty of commentary from the readers about individual stories they like—and hate. While these letters usually don't contain a list of all the stories in an issue, ranked in order of the reader's preference, they still let the Editor know how individual stories pleased or displeased the reader.

The second function of the AnLab,



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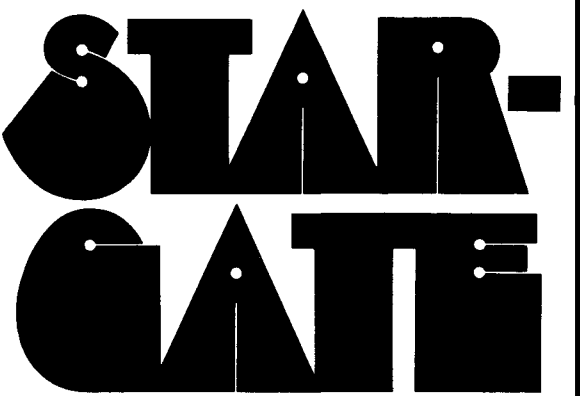


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rewarding the writers of the best-liked stories, will be taken over by our increase in the top rates we pay for fiction. For more than a decade, Analog has paid five cents a word for stories up to 7500 words in length and three cents per word for longer stories. In that time, the cost of living has risen almost asymptotically and the cover price of the magazine has doubled. Yet the writers have not received an increase in their income, except for the possible bonus stemming from the Analytical Laboratory.

So, effective immediately, Analog's top rates for fiction will be six cents per word for short stories (up to 7500 words) and four cents per word for longer stories. Note that this will be our *top* rate. Not every writer will receive it, because what we are doing is essentially redistributing the monthly bonus money from the AnLab in a new and more equitable manner. The increase in our cover price will go strictly to pay our increasing production costs.

This new top rate will be given to Analog's regular contributors, the writers who appear in the magazine frequently. If this seems like a leaning toward the writers who continually produce enjoyable stories, it is. But that doesn't mean that new writers, or occasional writers, cannot win the higher rates for their stories. Every story published in Analog will get *at least* the 5¢/3¢ rate. If you write only one story in


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But now you have an incentive for producing more than one story, more than a rare appearance in print. Become a frequent contributor to Analog and you can win the new, higher rate of 6¢ and 4¢.

How often is "frequent?" Frankly, we will pay this top rate for the top stories and the top writers. And we will pay it as often as we can without driving the magazine into the red.

The demise of the Analytical Laboratory leaves something of a gap in our readers' features department. This gap will be more than filled by the new photobiographical feature that you will find starting in this issue. Jay Kay Klein, who is science fiction's photographic chronicler, will write these biographical sketches of our authors and artists, as well as provide the photographs for this new feature.

One more piece of news, good.

As you have probably already noted, Analog has stuck a toe into the recording business. Our first (read, *trial*) recording is a dramatic presentation of Isaac Asimov's classic story, "Nightfall." If it sells well we will do more recordings, and bring more dramatizations of both "Golden Age" classic stories and of newer tales to you. Our approach is to dramatize the stories rather than have someone merely read them to you. We figure that you can read the stories for yourselves, aloud if you like. The recording medium should be used for what it does best: adding the extra dimension of drama and audio imagination to the science fiction stories we love most.

Assuming that "Nightfall" is a smashing success, what should we do next? Which stories, which types of stories, do you think would do well in the audio format of LP records? Should we be recording other things, as well as stories? Should we stick to the classics of the field or concentrate on newer material? Should we include authors' comments on the stories, as we have with Asimov on "Nightfall?"

It has been exactly five years since I wrote my first Editorial for Analog. Five years, sixty issues of this magazine, at least 25,000 manuscripts read, four Hugos for Best Editor, four more Hugos to Kelly Freas for his illustrations, eight additional Hugos and Nebula awards for stories we've published, a continuous stream of marvelous readers, writers, illustrators visiting the office and corresponding from all over the world, the unstinting help of Kay Tarrant, Herb Stoltz, Diana King, Andrea Suarez, Victoria Schochet, Robert Fones.

It's been a good five years. There have been down periods, of course. There have been bad days. I hate the necessity of raising the cover price of the magazine. It bothers me and I know it bothers you. But, altogether, these past five years have been grand. If you have enjoyed them as much as I have, then the next five should be even better. THE EDITOR



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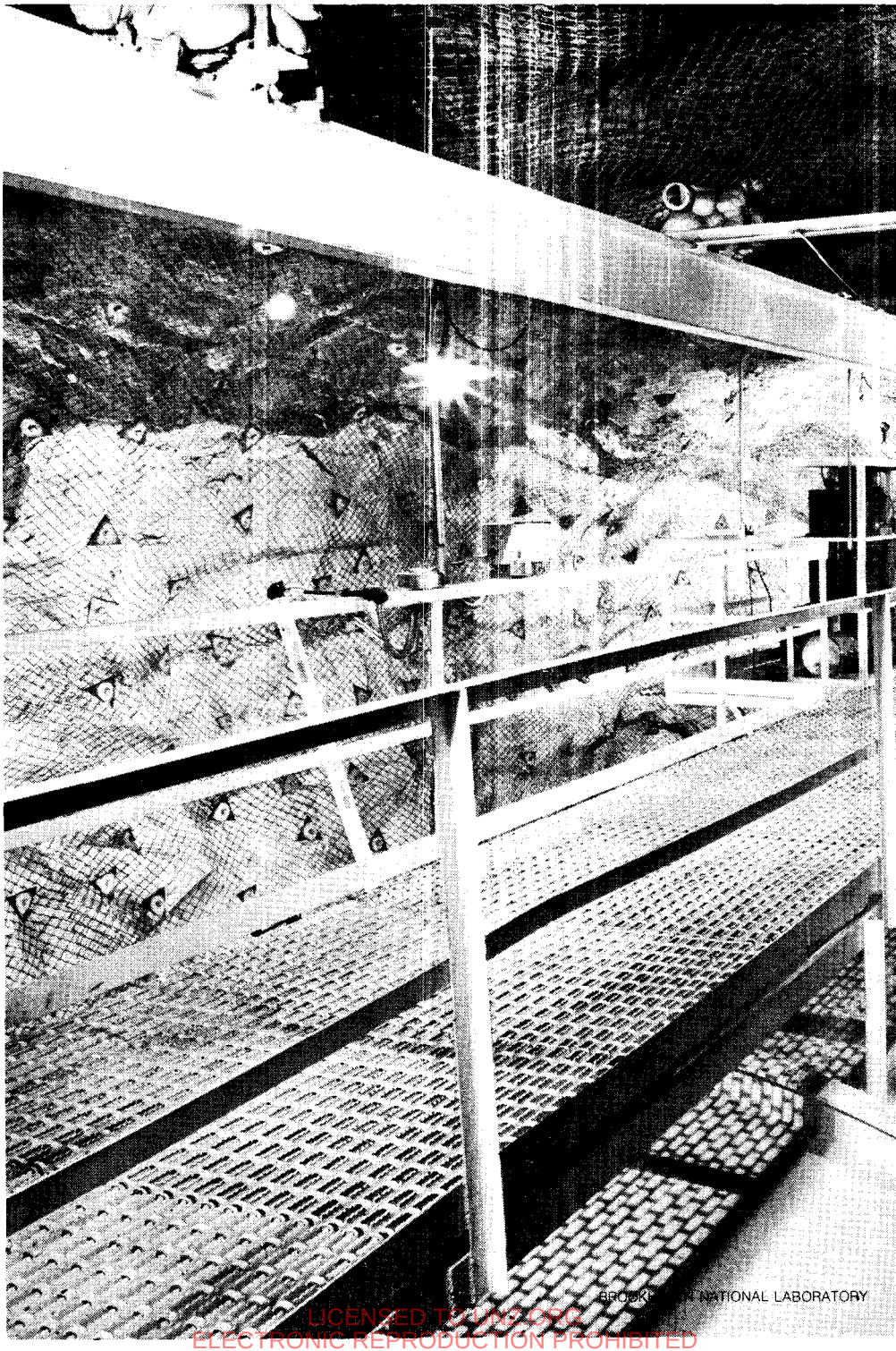

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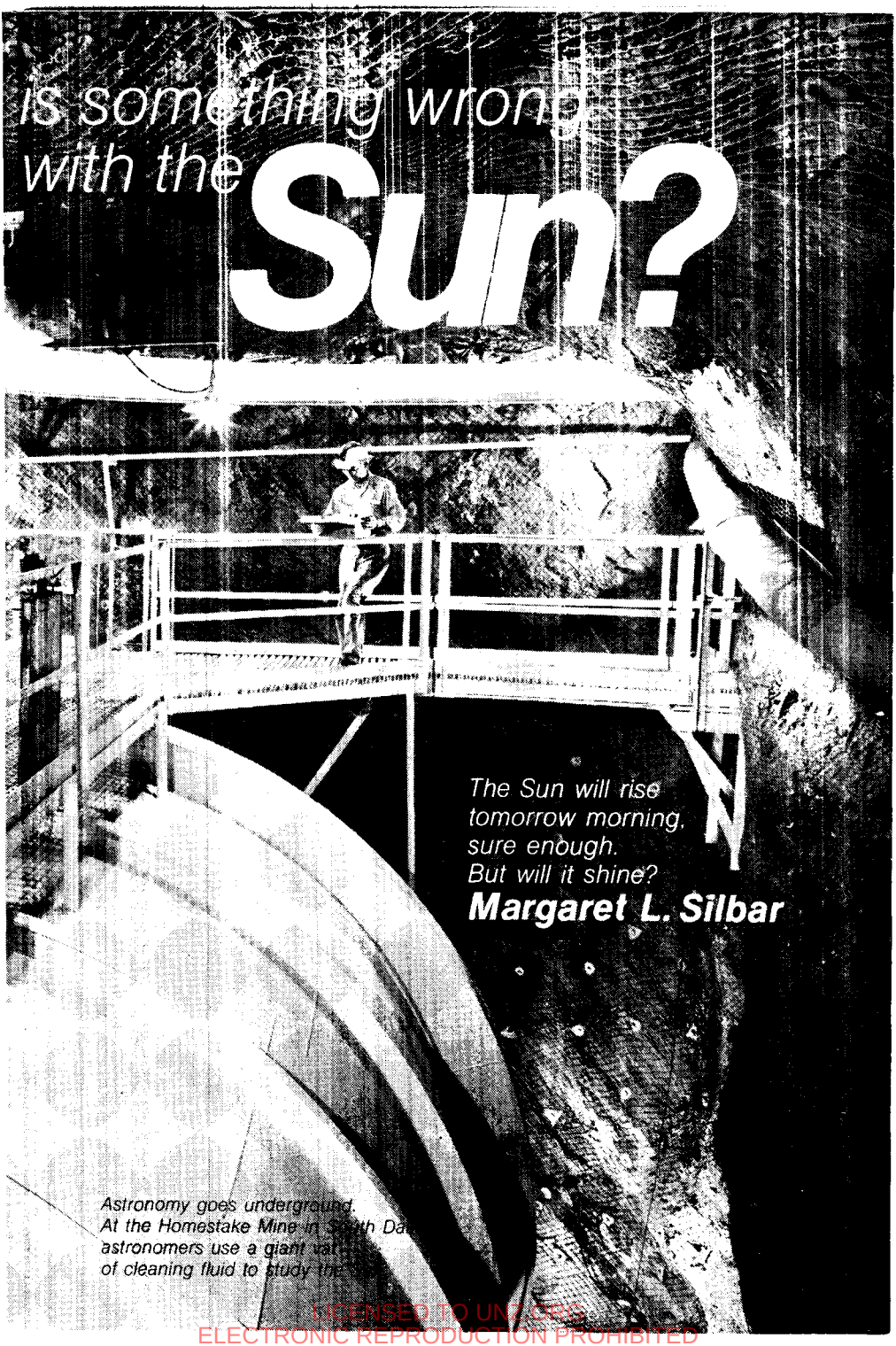
# is something wrong with the Sun?



*The Sun will rise tomorrow morning, sure enough. But will it shine?*

**Margaret L. Silbar**

*Astronomy goes underground. At the Homestake Mine in South Da[kota] astronomers use a giant vat [of] of cleaning fluid to study the [Sun]*

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Almost all primitive peoples worship the Sun as a god. Perhaps rightly so, for the Sun is the ultimate source of all the energy that gives rise to those organized collections of atoms and molecules that we call life. Indeed, the future of life on Earth is irrevocably bound together with the future of the Sun—when the Sun dies, so do we. (Unless, of course, we have by that time moved off to live in some other solar system.)

Up until quite recently, everything we knew about the Sun came from observations of its surface. There was no available tool to study the solar core until the mid-fifties and the first observation of neutrinos—elusive, weakly-interacting, putatively massless, uncharged particles.

Neutrinos, precisely because they practically never interact with anything, "shine" right out of the middle of the Sun's furnace. They travel at the speed of light from the solar core to the Earth in a mere eight minutes. Since they are born in the same reactions that make the Sun shine, they can tell us what was happening there when they left.

It is these solar neutrinos that were being looked for, a mile down in the Homestake Gold Mine in Lead, South Dakota, when Raymond Davis and his colleagues began setting up an "observatory" there some ten years ago. To date, however, he and his colleagues have never seen anything that they are willing to attribute to a solar neutrino. In fact, the upper limit they place on the arrival rate of neutrinos is rather smaller than any "reasonable" solar model would predict.

That's more than passing curious. Is something wrong with the Sun? We don't know yet, but in this story, we will explore some of the proposed answers to the question, ranging from "the experiment is wrong" to "our physics must be changed drastically."

Neutrinos were first postulated by Wolfgang Pauli in 1930 to keep the bookkeeping entries of the conservation laws straight. Without the neutrino, there was an apparent contradiction of these laws whenever a radioactive nucleus decayed. When experiments measured the total energy of a nuclear system both before and after the so-called beta decay, the energy budget was invariably unbalanced. A modern-day example of a nuclear beta decay reaction is the decay of a neutron, $n \longrightarrow p + e^- + ?$, where $n$ is a neutron, $p$ a proton, and $e^-$ an electron. Not only do the proton and electron vary in total energy from measurement to measurement, but their total energy is almost always less than that of the parent neutron.

At this juncture, the alternatives were limited. Either something was sorely amiss with the law of conservation of energy (and, incidentally, also those of momentum and angular momentum), or there was some unobserved particle responsible for carrying the missing energy (and



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| | Age | Diameter | Luminosity |
|---|---|---|---|
| The Sun is born from a cloud of dust. | 0 | 50 | 500 |
| Nuclear furnace starts up: hydrogen is fused into helium. | 0.07 | 1 | 0.50 |
| The Sun today. | 4.70 | 1 | 1 |
| Core has exhausted available hydrogen. | 6 | 1.20 | 1.40 |
| Turns to hydrogen burning in shell. | 10 | 3 | 4 |
| Expands: red giant stage begins. | 10.60 | 50 | 1,500 |
| Helium burning in core is initiated. | 10.61 | 10 | 100 |
| Has expanded sufficiently to become unstable. | 10.63 | 400 | 10,000 |
| Planetary nebula: sheds matter into space. | 10.64 | Variable | ..... |
| White dwarf: bankrupt, or without nuclear fuel. | 10.65 | .01 | 30 |
| Black dwarf: oblivion. | 50? | .01 | 0 |

*Table 1. The Solar Life Cycle: from birth to oblivion in 50 (?) billion years. This capsule history of the Sun, reflecting our current ideas as to its evolution, projects expected diameters and luminosities in terms of today's. Ages are in billions of years.*



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momentum and angular momentum) away. Pauli chose the less-radical solution and postulated the existence of a neutrino,* symbolized by $\nu$, to fill in the open slot in the neutron-decay equation, which could now be written as $n \longrightarrow p + e^- + \nu$.

Enrico Fermi picked up where Pauli left off, and, in a 1934 paper, pointed out that not only was a neutrino the savior of the conservation laws, but that something more about the mysterious process of beta decay could be understood in terms of the neutrino. Even before Fermi, it was evident that the neutrino interacted weakly with matter (we will come back to this), but it was essentially Fermi who introduced the concept of "the weak interaction."** At this point, physicists recognized two other interactions, or forces, as fundamental: gravity and the electromagnetic force. Later, the nuclear, or strong, force was recognized as a fourth basic interaction.

The physicists of the 1930s concluded that the detection of a neutrino, once produced, was impossible, and its discovery as a free particle was delayed until the fifties with their powerful nuclear reactor antineutrino sources. The experiment which demonstrated that neutrinos are indisputably real took place in 1956 and was designed and executed by a Los Alamos group led by Clyde Cowan, Jr., and Fred Reines. The experiment was based on essentially the same reaction as the neutron decay, but with the reactants and products "reversed," $\nu + p \longrightarrow n + e^+$, where $e^+$ is a positron, the electron's antiparticle. True, the particle that Cowan, Reines and their colleagues saw was an antineutrino, $\nu$, rather than a neutrino, $\nu$, but, in this case, "observation of an antiparticle is as good as a particle."

The neutrino's importance to astrophysics lies in the fact that it does interact weakly. One consequence of this is its incredible ability to penetrate *anything*, even if it were, say, a lead wall 1,000 light-years thick. Once a neutrino is born, it retains its energy and direction and is unaffected by anything other than the Universe's gross gravitational field.* Thus, a neutrino is unlike any other kind of solar radiation: it comes directly to us from the solar core in 500 seconds.

Long before free neutrinos were observed, astrophysicists were convinced that the concept of the weak interaction could help them understand how stars in general and our

**The name actually comes from Fermi, from the Italian for "little neutral one." Pauli originally thought to call it a "neutron," but soon after, the heavy neutral particle we now call a neutron was discovered by Chadwick.*

***One physicist "explains" this by turning to the Bible: "God created the weak in order to confound those things that are mighty." 1 Corinthians 1.*

**Some people suggest that neutrinos born in the Big Bang may, in fact, account for the so-called "missing mass" of the Universe.*



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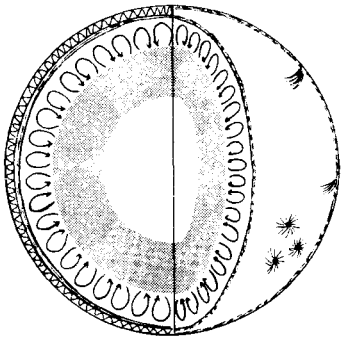

*FIGURE 1. The Sun's hypothesized structure. Energy is produced in the solar core and carried by radiative processes through the shaded area (the radiative zone), and thence into the convective zone. Mass motions carry the energy up into the chromosphere and, finally, to the photosphere, or visible surface. It takes one to ten million years for photons produced in the core to work their way to the solar surface. Sunspots and solar flares, sketched in at the right, result from pieces of magnetic field which, after being buried in the Sun for hundreds of years, have risen to the surface.*

Sun, in particular, shine so brightly and for such long times. Our Sun—thought to be in the simplest stage of evolution, that of a quiescent main sequence star—must have been shining, much as we know it today, for $4.7 \times 10^9$ years.* (Table 1 summarizes our ideas about when the Sun was born and how it will evolve.)

Given this age of the Sun and its mass, which is known to be $2 \times 10^{33}$ grams, or 343,000 times greater than that of the Earth, its entire internal structure can presumably now be determined. Only one more ingredient is necessary: its initial chemical composition, which is usually assumed to be almost identical to that observed on the solar surface: i.e., 79% hydrogen, 19% helium, and 2% heavier elements such as carbon, nitrogen and oxygen. Using the solar age, a homogeneous initial composition (this is the conventional assumption), and well-known physical laws, physicists can put together a complete model of the Sun. This usually involves a computer to integrate the controlling differential equations from the Year One to the present, keeping track of the chemical and structural changes in the Sun at every stage. Of course the "mathematical present" that one ends up with must be like the Sun as it actually is today. If not, the model-maker has to go back and fiddle with some initial parameter and repeat the whole calculation until he gets agreement.

The gross structure of the Sun, as it is presently understood, is shown in Figure 1. Energy is produced somehow in the solar core, where temperatures of 15 million degrees Centigrade and densities 100 times that of water prevail. The energy produced

**In this notation, $10^9$ years is 1,000,000,000 (a billion) years; it is 10 raised to the ninth power, all of which only means that it has a total of nine zeros attached to it. The notation is similar for negative components; $10^{-9}$ is thus one billionth.*



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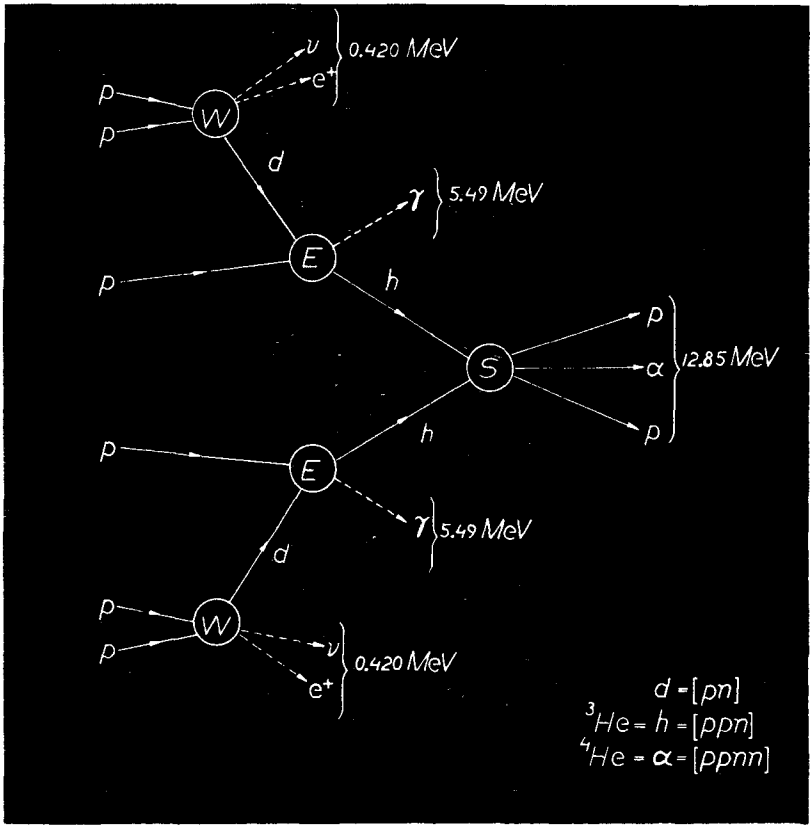


*FIGURE 2. How six protons turn into the nucleus of $^4He$ ($\alpha$), two protons (p), two positive electrons ($e^+$), two neutrinos ($\nu$), and two photons ($\gamma$). This is the simple p-p reaction chain. "W" stands for a weak reaction (very slow and improbable), "E" for an electromagnetic one (not fast, but quite probable), and "S" for a strong one (very fast and very likely). The neutrinos in this picture are low-energy.*

in the core is largely carried toward the surface by photons, the particles of light, as radiant energy. This radiant energy, unlike neutrinos, takes one to ten million years to diffuse through the enormous mass of material in the cooler outer layers of the Sun. It is slowed on its outward journey by atoms which absorb, reemit and scatter the radiation. These radiative processes carry the energy perhaps three-quarters of the distance from the solar core, where the so-called convective proc-



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esses then take over. Once in the convective zone, mass motions carry the energy up into the chromosphere and eventually into the photosphere and corona. From here, the radiant energy shines directly through the vacuum of outer space to Earth as photons.

The way the weak interaction is related to the life of the Sun is its intimate relation to the "somehow" that the energy is produced in the core. It was after the First World War that those incomparable pioneers of steller physics, Sir James Jeans and Sir Arthur Eddington, concluded that the Sun's future energy supply was "already hidden in its core" in the form of matter which could totally be converted into energy.

The tools for testing these ideas were not then available, and the suggestion of the nuclear origin of the Sun's energy was not fully worked out for twenty years more. Hans Bethe and a young student, Charles Critchfield, using ideas developed in the interim in Germany, showed in 1938 how four hydrogen nuclei could be fused into one helium nucleus. If one weighs the initial four hydrogen nuclei and compares them with the weight of the end product (i.e., the helium nucleus), it is clear that some small amount of matter has disappeared. It has been converted into energy, as Einstein had earlier told us could be done when he demonstrated the relationship of mass and energy in the simple equation, $E = mc^2$, where $E$ is the energy available from the complete conversion of some number of grams of matter, $m$, and $c$ is the velocity of light.

In the present case of fusing four hydrogen nuclei into one of helium, the total energy freed is $4.2 \times 10^5$ ergs* with each hydrogen nucleus losing 0.7% of its mass. Converting one gram of hydrogen into helium thus releases $6 \times 10^{18}$ ergs of energy, enough to keep a 100-watt light bulb burning for 200 years. Most solar models assume the Sun to be a constant, unchangingly luminous ball, which emits $4 \times 10^{33}$ ergs of energy per second. If this is correct, our Sun has, to date, completely burned up about 4% of its mass. Some of this energy works its way to the solar surface, and on to the Earth as photons, as already mentioned. In a normal star, such as our Sun is thought to be, some 3% of it is carried away by neutrinos.**

*An erg is another unit of energy and is about the amount an inchworm uses to crawl a centimeter. Other units are an electron volt (eV), which is $1.6 \times 10^{-12}$ ergs; a keV, which is 1,000 times that amount, and an MeV, which is a million electron volts.*

**An extreme case is a star on its way to becoming a runaway supernova. Neutrinos rapidly carry energy from its core, and, in this way, the core is cooled. This "energy rot" from within the star causes it to gravitationally collapse, which in turn causes the outer layers to explode away.



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The particular chain of the thermonuclear reactions responsible for energy generation in the Sun is known as the proton-proton chain (ofttimes abbreviated as the p-p chain). Another chain of reactions, which accounts for about 10% of the solar energy generation, is the carbon-nitrogen-oxygen cycle. We will not talk about the latter here, since it is thought to be considerably less important in the Sun than the p-p chain. In stars with higher core temperatures, the importance of the two chains seems to be reversed, with the CNO cycle being predominant. Hydrogen is, however, burned up into helium in both processes, and the total energy produced in both sets of reactions is the same.

The p-p chain, in all its complexity, is illustrated in Figures 2 through 5. The chain is triggered off, as in Figure 2, when the two nuclei of the simplest of all elements, hydrogen, collide. One can think of this as the collision of two protons, since the nucleus of hydrogen contains just a single proton. A minute fraction of the time, these two hydrogen nuclei react "weakly" to form a deuteron, a positively-charged electron, and a neutrino: $p + p \longrightarrow d + e^+ + \nu$. The deuteron, $d$, is a bound state of one proton and one neutron, and, together with an electron, forms an atom of deuterium, or heavy hydrogen. This step of the reaction releases some 0.420 MeV of energy, some of which appears as heat when the positron, $e^+$, stops and annihilates, and some as a loss when the low-energy neutrino leaves the core.

The chain of reactions then continues. Almost immediately after it is formed, the deuteron finds yet another proton and interacts with it, to form the light (and rare) isotope of helium. The chemical symbol for this atom is $^3$He (which is read as "helium-3"), and we will use $h$ as a symbol for its nucleus. A photon, denoted by $\gamma$, is also emitted in this reaction, $p + d \longrightarrow h + \gamma$. Again more energy is released, 5.49 MeV this time. The helium so formed eventually reacts with another helium atom (this second $^3$He atom is formed by a repetition of the first two steps in the chain). The two light helium atoms combine into yet another helium atom, this time the more common one with two protons and two neutrons ($^4$He), freeing two protons along the way, $h + h \longrightarrow \alpha + p + p$, where $\alpha$ denotes the $^4$He nucleus ("an alpha particle"). Still more energy is released, 12.85 MeV, in fact, and the cycle is complete.

Alternatively, a similar initiating process could produce a neutrino with an energy of 1.44 MeV in what is called "the pep reaction." Two protons and an electron collide at the same time, as in Figure 3, and form a deuteron and a neutrino. The end result is basically the same as in the $p + p \longrightarrow + e^+ + \nu$ reaction, the only difference being the slightly larger energy of the neutrino. For every 400 p-p reactions, only one pep reaction occurs. The reason for this is that it is



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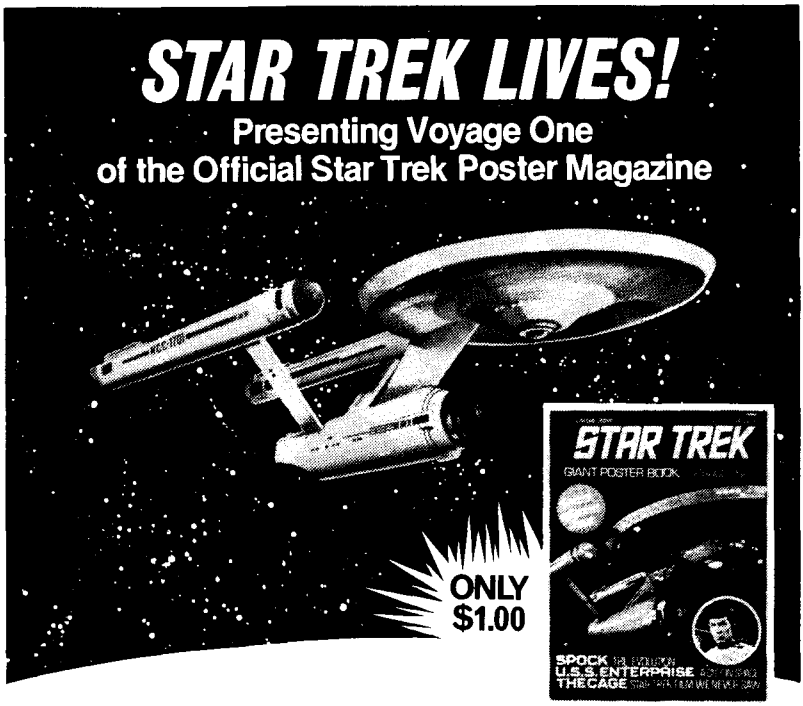


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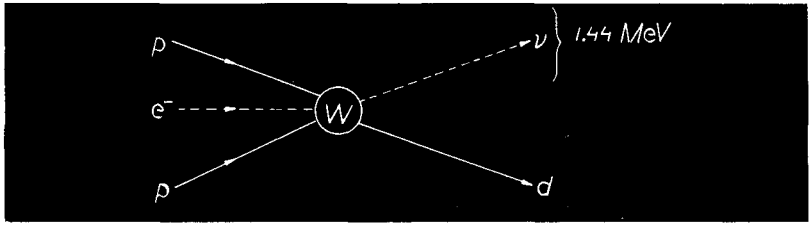


*FIGURE 3. Here the initial reaction can be replaced by what is called "the pep reaction." This is still a weak interaction, and, while it produces slightly higher energy neutrinos than the more-usual p-p reaction, these neutrinos are not detectable in Lead, SD. After this variation on the initial reaction, the fusion process proceeds as in Figure 2.*

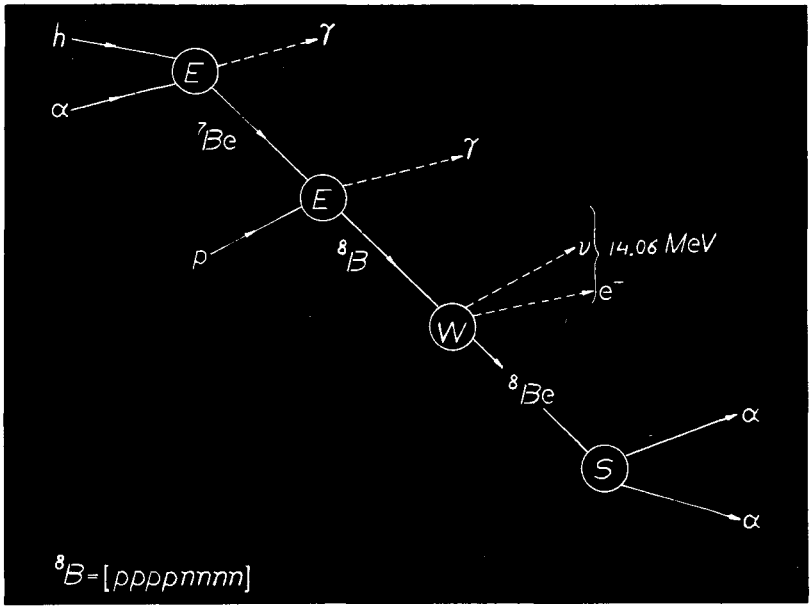


*FIGURE 5. Yet another alternative pathway. The beryllium nucleus ($^{7}Be$) captures a proton instead of an electron, emits a photon, transforming into boron ($^{8}B$). The boron throws off the all-important high-energy neutrino sought in the Homestake Mine and a positron, becoming a transient nucleus of beryllium, and thence decaying very quickly into two alpha particles.*



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just all that much more improbable for three things to collide rather than two. (The reaction chain then proceeds from this point, in the same way as illustrated in Figure 2.)

But there is the possibility of complications, as is shown in Figure 4. Instead of two nuclei of light helium colliding, one such nucleus can collide with one of the previously-produced less-rare helium atoms, $^4He$. In the process, beryllium ($^7Be$, consisting of four protons and three neutrons) is created and a photon is emitted, $h + \alpha \longrightarrow {}^7Be + \gamma$.

This beryllium nucleus is radioactive. Left alone, it will capture an electron to form stable lithium ($^7Li$, with three protons and four neutrons) and a neutrino with an energy of 0.861 MeV, ${}^7Be + e \longrightarrow {}^7Li + \nu$. The weak electron capture process here has a "half-life" of 53 days, half-life being the time needed for its radioactivity to diminish by half. Thus the possibility exists that something might happen to the beryllium nucleus *before* it has a chance to capture an electron, and this alternative and somewhat rare pathway is shown in Figure 5.

As in Figure 4, an $h$ and an $\alpha$ react to produce beryllium. The beryllium, however, this time collides with a proton, transforming into boron ($^8B$), and throwing off a photon, ${}^7Be + p \longrightarrow {}^8B + \gamma$. The boron then decays weakly, producing a beryllium nucleus ($^8Be$), a positron and the all-important high-energy neutrino, ${}^8B \longrightarrow {}^8Be + e^+ + \nu$. Finally, the beryllium, in its turn, immediately decays into two helium ($^4He$) nuclei, ${}^8Be \longrightarrow \alpha + \alpha$, and we have come full circle, turning four hydrogens into one helium.

While less-energetic neutrinos produced earlier in the chain can, in principle, be seen experimentally, the beta decay of boron would produce neutrinos of up to 14 MeV. In 1958, W.A. Fowler and A.G.W. Cameron independently pointed out that this alternative reaction of an ordinary helium nucleus with a not-so-ordinary one, an alpha particle, occurs more frequently than had previously been thought. It was at this point that people began to believe there was indeed a possibility of seeing neutrinos from the Sun.

As was mentioned earlier, the first free neutrino seen was actually an antineutrino. An antineutrino can be detected using a target rich in protons, for example, hydrogen. To see a neutrino, however, a neutron-rich target is needed. Free neutrons, however, are not available as a target material: there is no way of maintaining a large-scale collection of them in one small volume.

What one can do, in the absence of free neutrons, is make use of neutron-rich nuclei. In the mid-fifties, following the earlier ideas of Bruno Pontecorvo and Luis W. Alvarez, Raymond Davis developed a radiochemical technique—a "tour de force" of modern chemistry—whereby one could try to see the



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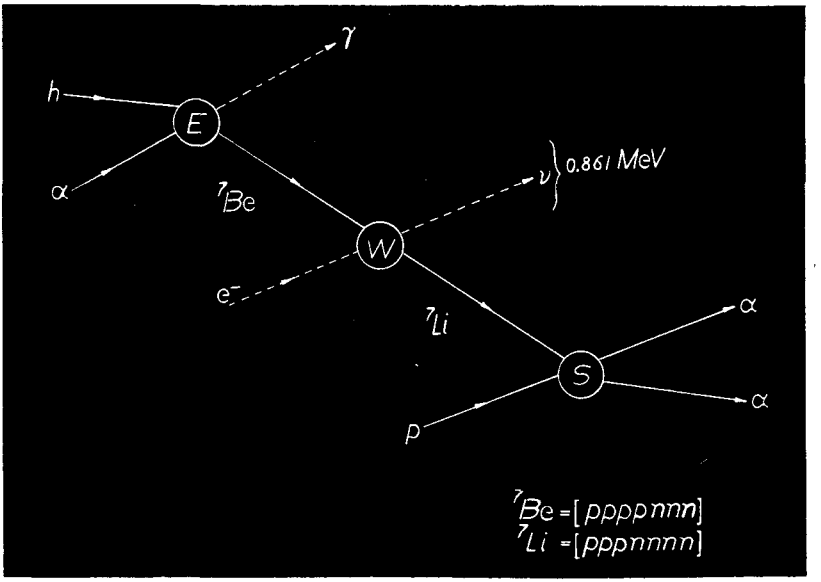


*FIGURE 4. A complication in the p-p chain. Instead of two nuclei of $^3He$ (or h) reacting, one such nucleus can react with one of $^4He$ (or α) to produce beryllium ($^7Be$), and, eventually, lithium ($^7Li$) and two alpha particles. But still no high energy neutrino is created. The weak electron capture process here has a half-life of 53 days. Hence there is the possibility that something might happen to the beryllium nucleus before it has a chance to capture an electron, and this possibility is shown in Fig. 5.*

interaction of solar neutrinos with an isotope of chlorine ($^{37}Cl$). This isotope makes up about one-quarter of all chlorine atoms. Its nucleus contains 17 protons and 20 neutrons. If one of these neutrons absorbs a neutrino, it becomes a proton and emits an electron, $\nu + n \rightarrow p + e^-$. The nucleus then has 18 protons and 19 neutrons and has become that of a radioactive isotope of argon ($^{37}Ar$), which has a half-life of thirty-five days. This reaction, sought by Davis and his colleagues, is written as, $\nu + {}^{37}Cl \rightarrow {}^{37}Ar + e^-$.

The experimentalists' neutron-rich target is a 400,000 liter tank of perchloroethylene, an abundant, inexpensive chlorine-containing compound, used in dry-cleaning. The tank and detector are situated in the Homestake Mine, where physicists and gold miners labor simultaneously a mile underground. The miners can, at best, expect only a fraction of an ounce of refined gold from every ton of ore they dig out of the rock. Davis, in his turn, expected to



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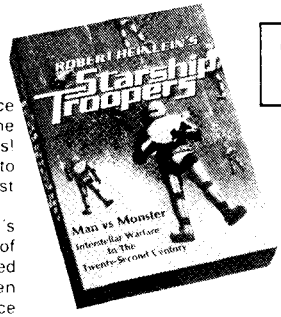
# STARSHIP TROOPERS



2156 A.D. ... and mankind comes face to face with an incredible, implacable enemy: the intelligent hive-spiders of Klendathu—the Bugs! Earth cities go up in smoke, and from Earth to Klendathu the battles rage. Bug warriors against the Starship Troopers!

This is the scene for Robert Heinlein's *Starship Troopers*, one of the all-time classics of Science Fiction—and now Avalon Hill has based a game on this classic story of conquest on alien worlds. The Starship Troopers strike from space with telepathic "Special Talents," nuclear weapons and power-suited soldiers against the subterranean hives and machines of the Bugs in *Robert Heinlein's STARSHIP TROOPERS*.

*STARSHIP TROOPERS* recaptures the spirit and flair of the book, with each scenario recreating one of the battles that dot the way to the final climax—the invasion of Klendathu. All of the battles of the book are here, along with more battles that are only mentioned in the book—Raid on the Skinnies, Operation Bughouse, Sheol, Operation Royalty, and the Invasion of Klendathu, among others. The game uses programmed instruction to add weaponry and rules as the player moves from game to game—the Bugs appear, moving in their underground passages and suddenly erupting onto the surface to blast the human Mobile Infantry away, while the Mobile Infantry counter with increasing numbers of special weapons: spider gas, nuclear weapons, engineer teams with special demolitions, and better weaponry for the Mobile Infantry troopers themselves--and "Special Talents", humans with special ESP powers to seek and find the Bug colonies.

The unit counters represent individual Mobile Infantry troopers and small groups of Bugs, Skinnies (another alien race), and human engineers. Special weapons and technology are represented—heavy beam weapons, mobile missile launchers, sensors and retrieval boats are among the counters that must be dealt with. There are rules for gas attacks, radiation, underground tunnelling and extra-sensory perception. Victory Conditions change from scenario to scenario, varying with the orders given to the Starship Troopers—raid the wavering enemy Skinnies, or make a beachhead on a Bug world.

The colorful and picturesque counters and mapboard are dramatic and pleasing to look at, and the rules have been designed to recapture the dramatic actions described in the book, whether landing from space or moving through the underground tunnels. In addition, the game extends and fills out the details of the conflict, adding weaponry and battles that are only hinted at in the book.

*STARSHIP TROOPERS* is a new direction in boardgames--a game that is a simulation and an extension of a popular science fiction novel. In the midst of the rising national interest in science fiction and science fiction games, it has been carefully designed for the enjoyment of both science fiction fans and gamers—and it should be especially enjoyable to everyone who has read and enjoyed Robert Heinlein's classic *STARSHIP TROOPERS*.

Finally, the rulebook has been filled with diagrams and illustrations and photographs, full of information and showing the nature of the units in the game. Have you ever seen a Bug Brain, or the layout of the Starship *Rodger Young*? All are here, as described in the book.

Heinlein, voted the first "Grand Master" of Science Fiction, has done more than just lend his name to the game. After authenticating the work he wrote the introduction which adorns the game box itself. *STARSHIP TROOPERS* sells for $10 plus the usual postage charges. Maryland residents add 4% state sales tax.

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capture a few neutrinos a day in the huge tank. The ongoing experiment is, though highly dependent on chemistry, fairly straightforward. ("Only plumbing," as Davis once said.) Pure argon (but, in this case, the stable nonradioactive variety, $^{36}Ar$) is added, in small amounts, to the tanks and stirred until it dissolves. This will "prime the pump" for the extraction of the radioactive argon.

The neutrinos the physicists hope to harvest after the tank sits undisturbed for one hundred days are high-energy neutrinos from boron decay (as shown in Figure 5). Without a doubt, a neutrino produced in this rare decay, with its relatively high energy, can, upon collision with a chlorine atom, be transformed into an argon atom some small, but presumably calculable, fraction of the time. Moreover, the resulting argon atom would have enough recoil energy to break free from its parent molecule. This atom will then, according to the theoretical script, slow down and stop, and, as such, it will behave like dissolved argon. After, hopefully, a crop is ready for harvesting, the tanks are flushed out with helium gas, thus concentrating the argon atoms. Concentrated, the argon atoms tend to show off their radioactive properties in a better light. About 90% of the original argon ($^{36}Ar$) introduced into the tanks is recovered. One would expect, says Davis, about fifty radioactive argon ($^{37}Ar$) atoms as well. What is found, however, is an insignificant number, which can in fact be attributed to "false signals" from a small cosmic-ray background, which, despite the depth of the observatory, nonetheless is present.

The Homestake Mine experiments set an upper limit of 1 SNU, where 1 SNU (solar neutrino unit) is $10^{-36}$ captures per target atom per second.* With 400,000 liters' worth of chlorine, one solar neutrino should be captured every single day. Instead, less than one is captured in five days. And this, says one theorist, "is just not a socially acceptable number in solar evolutionary circles." A standard conventional theoretical model predicts 5.6 SNU's, where 4.3 SNU's come from boron decay and 1.3 from neutrinos in all other branches of the p-p chain. Nonstandard models—though highly esoteric and therefore not readily believable—can with some amount of straining sometimes predict as few as 0.5 SNU.

The solar neutrino experiment, which started out to test our ideas of stellar and solar evolution, has instead presented us with a first-class mystery. Ever since the results first started coming in, scientists from many disciplines have been searching for loopholes. Easy ways out of the dilemma have been sought in the

**When this term first came into use, the pun making its rounds in the astrophysical world went, "What? No SNU's? No SNU's is bad news." The good news is that people gave up making this joke after a while.*



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experiment itself, in nuclear physics, and in neutrino physics.

There are people who are skeptical of the chemistry involved in Davis's technique. Does the argon so produced really become a neutral dissolved argon atom? Or when formed, is it somehow not able to free itself, but is trapped by a molecule or compound? Neither of these possibilities seem likely.

There are also people who are concerned about Runs 36, 37 and 38. These three recent runs—without the experiment having been changed in any way—have each detected neutrinos at a flux of approximately 4 SNU, in contrast to the previous ten runs whose average flux has been at most a third of a SNU (.28 ± .09 SNU). Davis himself is unconcerned and attributes the larger flux to statistical fluctuations. In fact, in 1972, one run (included in the average of 0.28 SNU) had a flux of 5.5 SNU. "Nothing is changed," says Davis. "Whatever is right with the experiment continues to be right with it." Time, of course, will tell.

The nuclear physics questions in abeyance concern the p-p chain. No one has ever been able to experimentally check the first step in the chain since the weak interaction of two protons is so rare an occurrence. It is "a lucky circumstance" that this part of the chain can be theoretically determined. The calculation done at this point requires both a knowledge of the structure of the deuteron and of the way two low-energy protons


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interact when they collide. The latter information can be obtained by extrapolating from the behavior of high-energy protons, which can conveniently be made to collide in a laboratory situation, to that of lower-energy protons, such as those naturally occurring in the solar core. There are people in the physics world who are now worrying about the accuracy of such extrapolations, although it seems hard to imagine there could actually be anything wrong here.

Yet another "weak" point in the chain of argument could be the neutron—the long-lived particle that is essentially responsible for the stability of our world. It, when joined together with a proton to make a deuteron, has an infinite lifetime. When free, it has a half-life of 11 minutes, which has come to be considered as a well-known fact, a part of the folklore, so to speak. But, in fact, to measure this important lifetime is very difficult, and it has recently been revised downward by about 9%, and more revisions may yet be in store. Any such revisions would, of course, affect the as-yet-only-calculated neutrino-capture rate for the $^{37}Cl \longrightarrow {}^{37}Ar$ reaction,* as well as the weak interaction steps throughout the p-p chain.

The third kind of "easy out" is an idea which may be "equally as outrageous" as that of Pauli who proposed neutrinos in the first place. John Bahcall of the Institute for Advanced Study in Princeton and his colleagues have suggested that neutrinos are not, after all, massless. They point out that a neutrino with a mass—however miniscule—could decay into a presently unknown less-massive particle sometime during its 500-second voyage to Earth.

In laboratories, however, neutrinos seem to be stable particles. What Bahcall and friends are therefore suggesting is that the neutrino, while apparently stable over laboratory distances ($10^4$ cm.) is in fact unstable over astronomical distances ($10^{13}$ cm.). While Bahcall points out that this does "cut the Gordian knot in one fell swoop," he is forced to admit it is "not pretty." For it destroys much of the elegance of weak-interaction theory by saddling the neutrino with a mass.

An equally-as-imaginative (i.e., outrageous) suggestion comes from Pontecorvo in the USSR. One kind of neutrino may, it is proposed, turn into another kind during the eight-minute trip to Earth. It turns out, as was shown in a clever experiment in 1962, there are *two* kinds of neutrinos, the neutrino associated with an electron (the one discovered in 1956) and a neutrino associated with another elementary particle called a muon. Muons are something of a riddle in the elementary particle zoo: they seem to be identical to the electron, except that they are about 200 times more massive. And if

**There is, however, a proposal to measure this capture rate at the Los Alamos "meson factory" in northern New Mexico.*



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conservation laws are *also* to be preserved in the decay of muons, then this second breed of neutrino is necessary.

Electron neutrinos, so goes the Soviet suggestion, may turn into muon neutrinos, and vice versa. A possible explanation of why this process has never been detected here on Earth—and indeed it has not—is that astronomical distances are necessary for the neutrino to take advantage of its double identity. When born in the solar core, the neutrino is that of the electron; during its travels it undergoes quantum oscillations, according to this theory. At the Earth, if detected, it would be so in its muonic state. (The solar neutrinos Davis *et al* have been trying to capture in South Dakota can only be those associated with the electron.) Eight minutes later on the neutrino's journey away from the Sun, it would presumably have oscillated back to an electron neutrino. Et cetera, on out to infinity.

All these initial proposals, however, seem to be no more than ad hoc ways out of the solar neutrino conundrum. There are thus those who are now turning to our solar model calculations and wondering if they are in fact sophisticated enough to explain the Sun in all its subtlety. While a detailed solar model is not necessary to predict the *total* number of solar neutrinos emitted, one is needed if we are to understand how many neutrinos are produced in any one part of the chain. This kind of information is quite important, for the Davis detection method permits us to see only the highest energy neutrinos emitted from the Sun. The number of neutrinos with any particular energy, however, is highly sensitive to the temperature of the solar core, its density and composition.

There are various possible invalidities in some of the current solar models. Astrophysicists have generally presumed that the core had a homogeneous initial composition, and this may be one problem. For the chemical composition of stars is, unfortunately, "an important, but unsafe" subject. To indicate how truly unsafe, one need only look back some forty years to the time when hydrogen and helium, the apparently major constituents of our Sun, were not even considered abundant in the interior of stars.* New values for the relative abundance of hydrogen in the Sun—and other elements such as iron—could very well affect our ideas about how many neutrinos the Sun is (or should be) sending out.

Another possible weak point, and variation on the same theme, is the Sun's age. If it were older than we now estimate, then its composition

**This was common belief in spite of the fact that helium, the second most abundant element, was first discovered in the 19th century by examination of solar spectrograms. Hence, its name, which comes from that of the Greek sun god, "Helios." Only much later was helium found on Earth.*



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would be quite different. For example, a very old star, born of unenriched material, has only about 10% of the heavy-element content of the Sun, and therefore a different temperature.

An example of how one's model can lead to grief is the temperature dependence associated with boron production and that of the high-energy neutrinos created in its decay. It has been noted that if the core temperature over the last million years has *decreased* by something in the neighborhood of three million degrees, the small high-energy neutrino flux could be explained. The observed solar luminosity could all be produced at a low enough temperature so that no boron is ever even produced! When physicists first realized that boron production depended on the temperature predicted by whatever solar model was being used, they were lulled into believing that the discrepancy between theory and experiment was more apparent than real. This is not the case, however, since almost all standard solar models tell us the Sun's central temperature is now rising. The problem is still with us.

The Sun therefore has become what, in moments of astrophysical levity, is called "a happy hunting ground for revolutionary ideas." One of the most heretical is that the Sun is not a constant, never-varying ball of light and fire. Sunspots provide one clue that the Sun is not the placid furnace we are sometimes wont to think it.* Their number rise and ebb, on the average every eleven years, as strong magnetic fields rise to the solar surface, after having been buried deep in the Sun for hundreds of years. If the magnetic field on the surface builds to a sufficient strength, solar flares, short-lived and intense, also occur. The temptation has been to disregard sunspots and flares as phenomena limited to the Sun's surface skin. Sunspot activity, however, continues to occur with an inexplicable regularity.

Possibly, the Sun is variable in still other ways; in its luminosity, for example. Now the actual luminosity of the Sun has been remarkably constant in this century, that is, ever since precise measurements have been made. But this is not evidence for a forever-constant Sun. Thus, a number of physicists suggest episodic and probably periodic core expansion in the Sun. In a temporarily expanded state, the nuclear fires banked, the solar luminosity would be less than normal. The Sun would essentially be mimicking a star of lower mass.

In most such models developed to date, the sudden mixing of helium ($^3$He), produced by the p-p chain as an intermediate product of hydrogen fusion, is the initiating event. Ac-

**The "purity" of the Sun and other heavenly bodies was a medieval tenet of the Church, and, thus, Galileo's telescopic confirmation of sunspots only increased his troubles with the Church.*



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cording to models such as that described in *The Solar Spoon* by F.W.W. Dilke and D.O. Gough of Cambridge University, England, helium builds up somewhat away from the solar center and causes an instability. The helium mixes into the Sun's central core, burning, and generating a large amount of energy. This energy affects the outer layers of the Sun surrounding the core, and they expand, causing temperatures in the solar core to drop. When the core temperature has dropped to below 3 $\times$ $10^6$ degrees Kelvin, thermonuclear reactions are no longer possible: it is too cold to get them started. The Sun's furnace shuts down. No more neutrinos are produced.

The Sun continues to shine, courtesy of photons produced millions of years ago, when the Sun was on, and only now having made their way to the surface. Mixing episodes such as this occur every 100 million years, say the model's authors, with each one lasting about 10 million years. At the end of a mixing episode, the Sun, once more in thermal equilibrium, starts up and continues on its evolutionary path.

There is perhaps another way of "mixing" the solar core, if, for instance, some of the magnetic field which appears as sunspots and flares on the surface diffuses deep into the Sun. Roger K. Ulrich of the University of California says if the magnetic field from the surface were to build up to a sufficient strength in the core, it could lessen the efficiency of convection,* leading to periods of low luminosity. If the Sun is now undergoing a period of high luminosity (after one, or several, of low luminosity), its *average* luminosity would be lowered. As would its neutrino emission rate.

Unfortunately, the predictions of these models do not seem to hang together when confronted with paleoclimatic evidence. Perhaps more disturbing, they require the Sun to be in a special state during the time of the Brookhaven experiment—making them very much "deus ex machina." The idea nonetheless remains an

*Recall that convection is the means by which energy from the core is transferred to the surface by motion of "chunks" of hot material.*


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intriguing one, which cannot be dismissed out-of-hand.

For, evidence on other fronts suggests a variable Sun. Geological evidence indicates the Earth was once a far warmer place than it now is. As apparently was Mars, which is now locked in an ice age, but which exhibits riverbedlike channels, in which water presumably once flowed freely. And, from astrophysics, we learn that a number of stars in the cluster of Praesepe have energy outputs which vary widely from the expected.*

We now come to the last set of solar models, which depart quite radically from conventional models and suggest new ways in which the Sun might have initially been formed. The first comes from Fred Hoyle, the British astrophysicist famous for his innovative physics as well as his science fiction. He posits that the Sun is not all of a piece. The interior is said to have been created in the Big Bang some twenty billion years ago, much as standard stellar evolutionary theory proposes. This core would contain about 30 to 50% of the Sun's mass and would have an unusually high concentration of iron, but a low initial concentration of helium.

The outer half of the Sun, according to Hoyle, was added on only five billion years ago, with a completely different composition from the interior. Energy generation is by the p-p chain in the interior, with the outer half playing little or no part. In order for energy to flow smoothly from the core to the exterior, the core becomes convective. Beryllium ($^7$Be), produced near the core's center, is distributed throughout the core. This effectively reduces the temperature in the core, and as discussed above, the production of boron (and thus the high-energy neutrinos) falls off rapidly, sufficiently rapidly to come up with a prediction of 0.5 SNU.

Another model of the same genre comes from J. Craig Wheeler and A.G.W. Cameron of the Harvard College Observatory and Smithsonian Astrophysical Observatory, respectively. They have proposed that hydrogen and helium may not mix below some critical temperature. If this is the case, gravitational separation could have taken place in the proto-Sun, giving it a nearly pure helium core and a nearly pure hydrogen outer shell. And, indeed, at high pressures and moderate temperatures, hydrogen and helium are expected to be at least partly immiscible.

A helium core would also lead to a reduction in the number of boron neutrinos. For the same number of proton-proton nuclear reactions per second in the Sun would be spread over a larger amount of hydrogen in the layer, and therefore the nuclear

**Thus, long-term temperature ranges near these stars are not "fixed," and the chances of Earthlike climates–perhaps even life–are broadened.*



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burning would take place at a lower temperature. Wheeler and Cameron are quick to point out that this could not come to pass if the helium core were too large. In this latter case, a narrower hydrogen burning shell would be formed, thereby raising the nuclear burning temperature.

The authors' model, constructed according to this scenario, predicts a neutrino flux at the Earth of from 1.5 to 3 SNU. This, they say, "might be said to represent agreement, of a sort, with observation."

Enough of speculations! We must now return to experiment ("the alpha and omega of theory") for clues as to how to proceed. The next experiment, already on the Brookhaven drawing board, will test not only the idea of nuclear fusion as the Sun's basic energy source, but also that of neutrinos as stable particles. This experiment will be set up to detect low-energy neutrinos, specifically the neutrinos produced as the p-p chain is initiated. Such an experiment is necessary, for the very existence of these low-energy neutrinos is guaranteed by the most basic of astrophysical ideas.

The best candidate for a target for such an experiment is gallium ($^{71}$Ga), which, unfortunately is, unlike chlorine, exceedingly expensive. As envisioned, gallium would capture neutrinos to produce germanium, i.e., $^{71}$Ge, an isotope with an eleven-day half-life. This experiment could detect neutrinos with as little energy as 233 keV. But someone somehow must come up with twenty tons of gallium. At a present price of about $250 a pound, that's a *lot* of gallium!

This experiment, and its less-expensive kindred, will no doubt take years to get ready. But it is probably only with new data that we will be able to sort out the different possible ways out of the dilemma. If even *low*-energy neutrinos are not being emitted from the solar furnace, something is very, very wrong with our Sun. Is it possible that our Sun will *not* peacefully continue evolving as a main-sequence star, until it reaches the Red Giant stage? Maybe our Sun is not, after all, "an ordinary star."

Perhaps the most frightening speculation along these lines is that our Sun might have had an accident: it may have run into a quite small black hole in the very recent past,* which is sitting on the core, gobbling up mass from the surrounding gases and regurgitating energy. Radiation pressure keeps more than just a little bit of matter at a time from falling into the hole, but eventually, say, 150 million years, the Sun will be eaten up from within by this cancer. Nightmares, anyone?

---

**This suggestion comes from D.D. Clayton of Rice University and his colleagues. According to this model, 51% of the Sun's luminosity comes from the black hole (which is about $10^{-5}$ of the solar mass), the rest from more conventional nuclear processes, which emit the equivalent of 1 SNU.*



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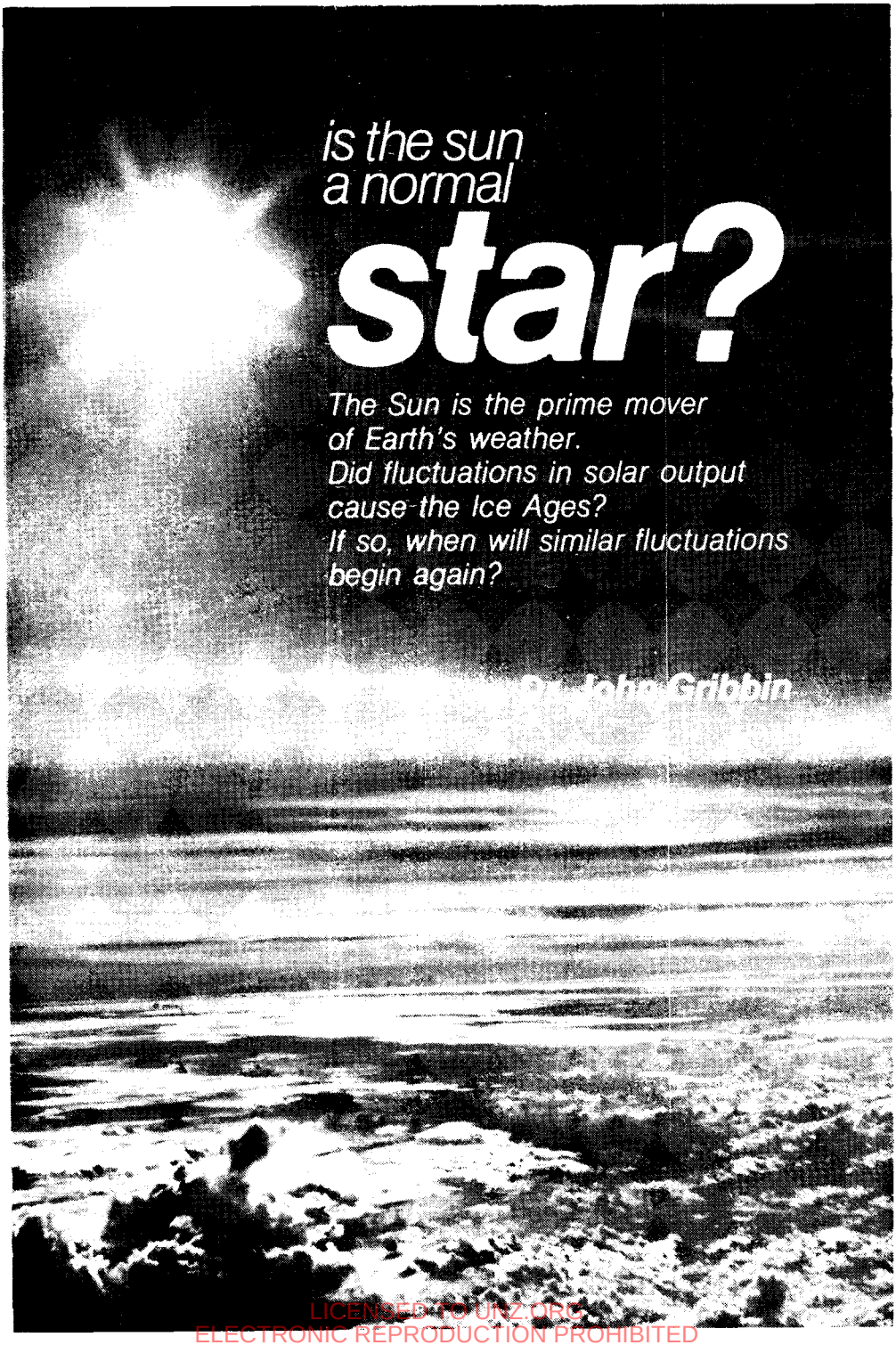


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It is now fifty years since Eddington wrote, "It is reasonable to hope that in a not too distant future we shall be competent to understand so simple a thing as a star." At that time, this hope might have seemed on the optimistic side to some people. The nearest star to us is the Sun, and it is natural to look upon this as an archetype which, once understood, would be the key to understanding other stars. But in the mid-1920s it was still something of a puzzle just how the Sun could exist in a hot, fiery state at the present time at all. The fossil and geological record on Earth provides a minimum timescale over which we know the Sun has existed, and this is much longer than it would take for any chemically burning Sun to exhaust its fuel. The first attempt by astrophysicists to resolve this dilemma was the theory that stars are powered by the heat liberated as they shrink to ever denser states under gravity's pull—with gravitational energy being converted into heat in the same way that a bouncing ball warms up (slightly!) as its energy is dissipated in heat. Even the timescale for that process, however, is only about thirty million years, a mere eyeblink by astronomical standards, and quite inadequate in view of the geological evidence that the Earth and solar system have been around for about 4½ thousand million years.

Over the four decades following Eddington's remark, however, things became a lot clearer as an understanding of nuclear fusion was developed, and increasingly as those decades went by his hope was seen as

Photo courtesy Los Alamos Scientific Laboratory

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the wise forecast of an elder statesman of astrophysics. First in theory, then in the awesome practice of the hydrogen bomb—a miniature star—the idea that energy could be released as simple atomic nuclei fuse together into heavier elements was developed. In essence, groups of four hydrogen nuclei (protons) can get together to form one helium nucleus; but the mass of the helium nucleus is less than the total mass of its constituent parts, and the extra mass has been liberated as heat energy, in line with Einstein's notorious rule $E = mc^2$. Hydrogen is the simplest and most common element in the universe, and makes up most of the mass of the Sun. There is no problem here in finding enough energy to keep the Sun hot for thousands of millions of years, or indeed for more thousands of millions of years yet to come, and it is no wonder that by the 1960s astrophysicists thought they really had the theory of stellar energy processes pretty well sewn up. They were in for a rude surprise—but before finding out more about that, and why it was such a surprise, we need to know a little more about just what their showpiece theory said about the workings of the Sun and other stars.

The idea of collapsing gas clouds providing heat for a star through conversion of gravitational energy turns out to be right, but only for the earliest stages in the star's life. Once the cloud has collapsed down to the size of a star, and the heat generated in the process has warmed its center to about ten million degrees, nuclear reactions begin and provide the energy to hold the star up against the continuing pull of gravity. Of course, eventually even nuclear fuel will be exhausted, and then the collapse will grind inexorably onward, producing a white dwarf, a neutron star, or even a black hole. But that is another story.

By the 1960s, the theory of stellar structure built up from nuclear fusion ideas seemed to be complete, and forty years after Eddington's statement of hope it seemed that the future he had envisaged had come. But all the evidence was, to some extent, secondhand—the beautiful theories seemed to work because when computer models became sophisticated enough to cope with the mathematical details needed to mathematically simulate a star, complete with nuclear fusion, then the numerical models "predicted" that a star with the age and mass of our Sun would have the radius and luminosity of our Sun. Then, however, it became possible, in principle at least, to measure directly processes going

*Fig. 1. One of the most gigantic solar eruptions ever photographed was captured by Skylab cameras, December 19, 1973. The arch of expanding plasma spans more than 367,000 miles across the solar surface. This photograph was made in the light of ionized helium by the extreme UV spectroheliograph aboard Skylab.*



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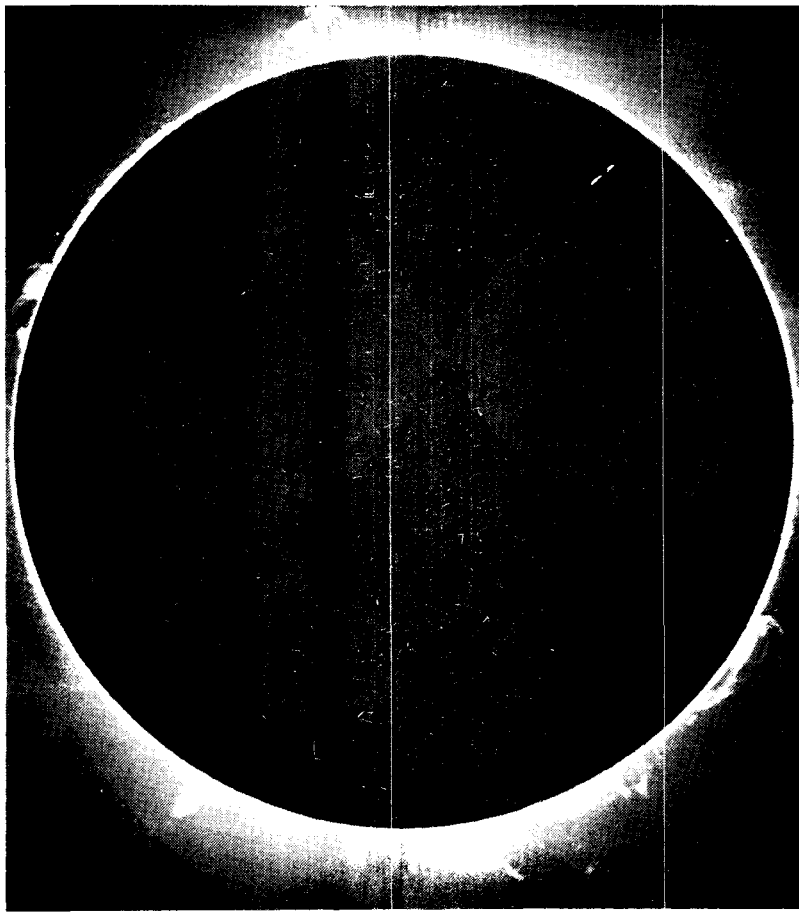

*Fig. 2. Prominences around the entire edge of the Sun, taken in the calcium K line, December 9, 1929.*

on inside the Sun; and at that point serious doubts were cast on our basic understanding of the Sun and stars. Those critical experiments were the attempts to detect solar neutrinos, which continue today and have as yet failed to detect neutrinos at the rate predicted by theory. (See Margaret Silbar's article in this issue.)

The idea of a particle that could be produced in nuclear reactions in the middle of the Sun and travel right through it and across space to be detected on Earth might have astonished even Eddington, but that is just what the best modern theories predict, and in the absence of any detectable flux of solar neutrinos only two possibilities are allowed. Either the theories of nuclear physics are wrong, or the theories of stellar interiors are wrong, at least as applied to the Sun. There are very good reasons not to discard particle interaction



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theory, not least since neutrinos are produced in particle experiments here on Earth. So what about the astronomical possibility? Can those wonderful detailed models really be that wrong? It seems they can. Taken at face value, the absence of any detectable flux of solar neutrinos today means that the center of the Sun must be at least ten percent cooler than we thought, so that critical reactions are 'switched off'; that's a big difference for a theory which a few years ago seemed to have all the answers down pat, but not so big that it cannot be explained by *modifying* the theory, rather than discarding it altogether.

And the best solution might be to keep our nice theories of stellar structure as a correct description of most stars for most of the time, and to look at the possibility that our Sun may either be an abnormal star or may be in a temporary, unusual state just now. Is it possible that even though the Sun produces no neutrinos today it has actually done so throughout most of its 4½-thousand-million-year lifetime? This is the straw at which astrophysicists have grasped to save as much as they can of their treasured theories, and in the process they have produced some ideas which range from the sublime to the ridiculous. Sticking as close as possible to the former category, the point is that the Sun takes a very long time, by terrestrial standards, to adjust to changes going on inside it. Switch off nuclear fusion and the Sun doesn't just go out like a light. It has a lot of stored heat, and it can also release more energy by contracting slightly, when gravitational potential energy is turned into heat.

After the interior is disturbed, it takes up to thirty million years for the whole Sun to adjust to changed conditions—a short enough time compared with 4½ *thousand* million years, but impressively long by human standards. If the geological record tells us, as it does, that the Sun has been hot for thousands of millions of years, but the absence of neutrinos now implies fusion is not going on as it should to keep the Sun hot for that long, the only satisfactory answer to my mind is that the Sun is not at present a 'normal' star—that it has gone 'off the boil' temporarily. This is intriguing enough in itself—it is even more intriguing when related to the fact that a theory of how the Sun might go 'off the boil' temporarily was published more than twenty years ago, before anyone was worried about solar neutrinos, in connection with a theory of ice ages.

The important feature of this idea is that although the central part of the Sun is a 'radiative' core, where energy is carried outwards chiefly by radiation, there is an outer 'convective' layer where energy is transported to a great extent by convection, with hot material bubbling outwards, cooling and falling back towards the hotter inner regions. According to our best theories



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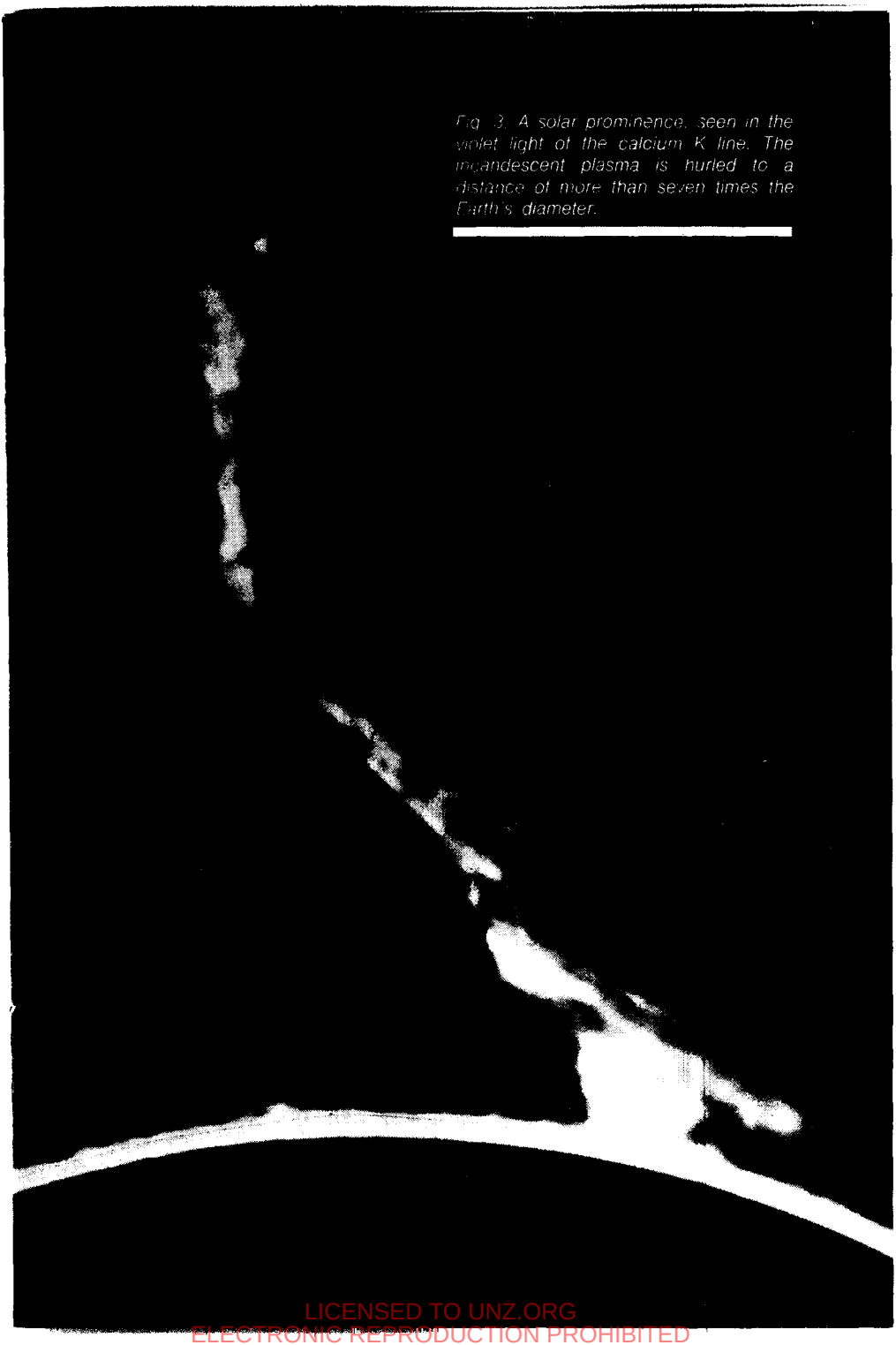

*Fig. 3. A solar prominence, seen in the violet light of the calcium K line. The incandescent plasma is hurled to a distance of more than seven times the Earth's diameter.*

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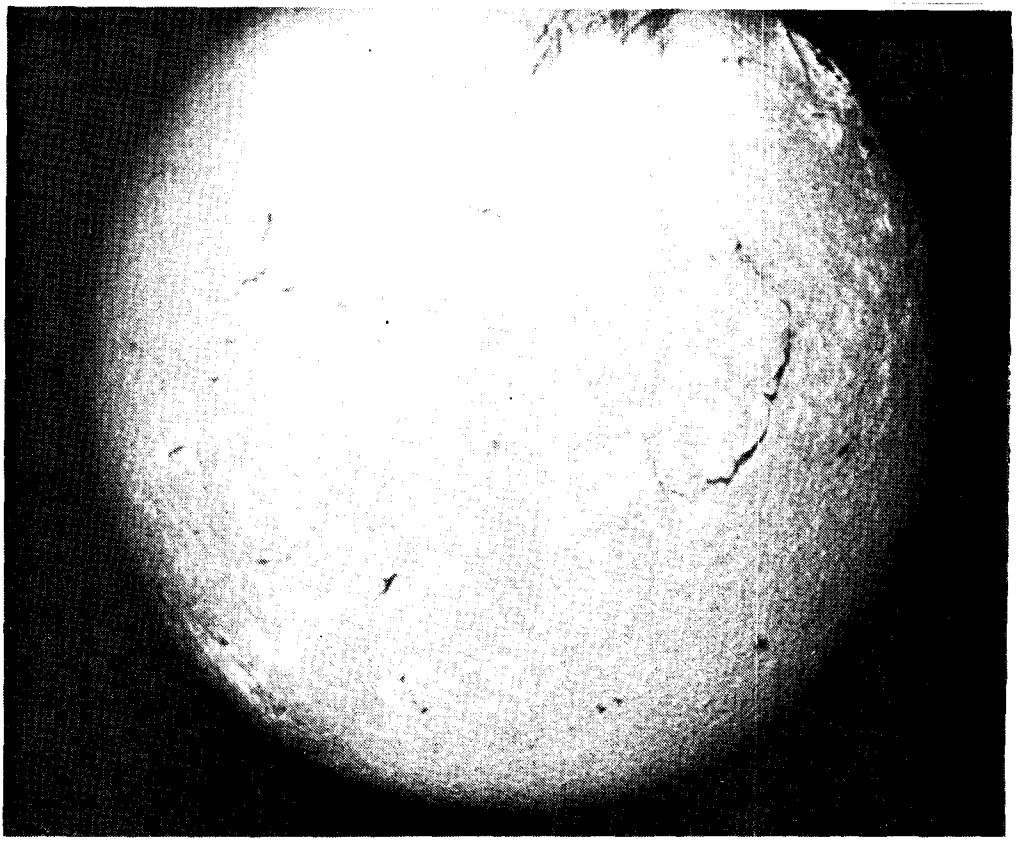

(NASA photograph)

of stellar interiors (which admittedly don't look as good now as they did in 1968) much of the Sun is not all that far from being triggered into a convective instability which would extend the range of this convective layer and churn up the interior rather more thoroughly than usual. If something happens to make the layer grow, it could spread out to produce this effect without furthur aid. And the result would be that the nuclear burning reactions in the interior would be temporarily switched off until the whole mass settled down into its more usual orderly state.

That seems to be just what we need—so much so that several different versions of this twenty-year-old idea popped up in the literature in the early 1970s. But they all contained one major defect. They did not explain in any satisfactory way why the Sun should happen to have gone off the boil just at the time we are around to watch it. This seemed too much of a coincidence to accept, and led to some suggestions that perhaps these solar fluctuations had produced the recent Ice Age which has been so important in stimulating the development of man's civiliza-



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*Fig. 4. The Sun as it appers in the light of ionized hydrogen-alpha emission, August 10, 1972. Vast solar disturbance visible in upper right limb (edge) caused a geomagnetic storm two days after it was first detected by Orbiting Solar Observatory 7.*

tion. According to that idea, we are here to notice the absence of solar neutrinos simply because there are no solar neutrinos! It's a nice touch, of which Sherlock Holmes would have been proud. But there is an even better way out of the difficulty.

As it happens, something unusual has happened to the Sun very recently by the standards of stellar timescales, and that something may have caused the disturbance which triggered a convective instability and switched off the production of solar neutrinos temporarily. It may also have caused the recent Ice Age and the emergence of civilized man, so that again it is no coincidence that we are here to observe the odd behavior of the Sun. But now we don't have to say that the odd behavior itself is just one of those things, we can point to a plausible chain of cause and effect.

This idea ties in events in the Sun and on Earth to the structure of our galaxy, and again draws on very old ideas sketched out decades ago by Harlow Shapley and updated recently by Bill McCrea. Our Milky Way galaxy is a fairly typical spiral, a class which gets its name from the two characteristic spiral arms of bright stars which trail outwards from the center. These arms are edged by dark lanes of gas and dust, and as far as we can tell these dark lanes are the true, permanent features of the spiral structure. They seem to be compression shocks in which new stars are born as gas clouds are squeezed small enough for nuclear burning to begin; because new, young stars are hot and bright, the bright spiral arms lie just 'downstream' of these dark compression lanes. But stars continue to orbit around the galaxy once born, and for a star at the distance we are from the galactic center it takes, very roughly, 200 million years to orbit the center of the galaxy once, and in each orbit we cross two spiral arms and their associated lanes of dust and gas. The plot thickens with the discovery that the solar system is now on the edge of a spiral arm—the Orion Arm—having just emerged from the dust lane 'upstream' of that arm. It is even possible that we emerged from the very dense dust cloud of the Orion Nebula only fifteen or twenty thousand years ago. That would certainly have some effect on the Sun—but would it be the effect we are looking for?

The best way we can find out is by using the computer simulations of how stars behave in binary systems, when gas from one star can overflow (especially in the giant phase) and cascade onto the companion. This should be a similar effect, superficially at least, to the rain of dust and



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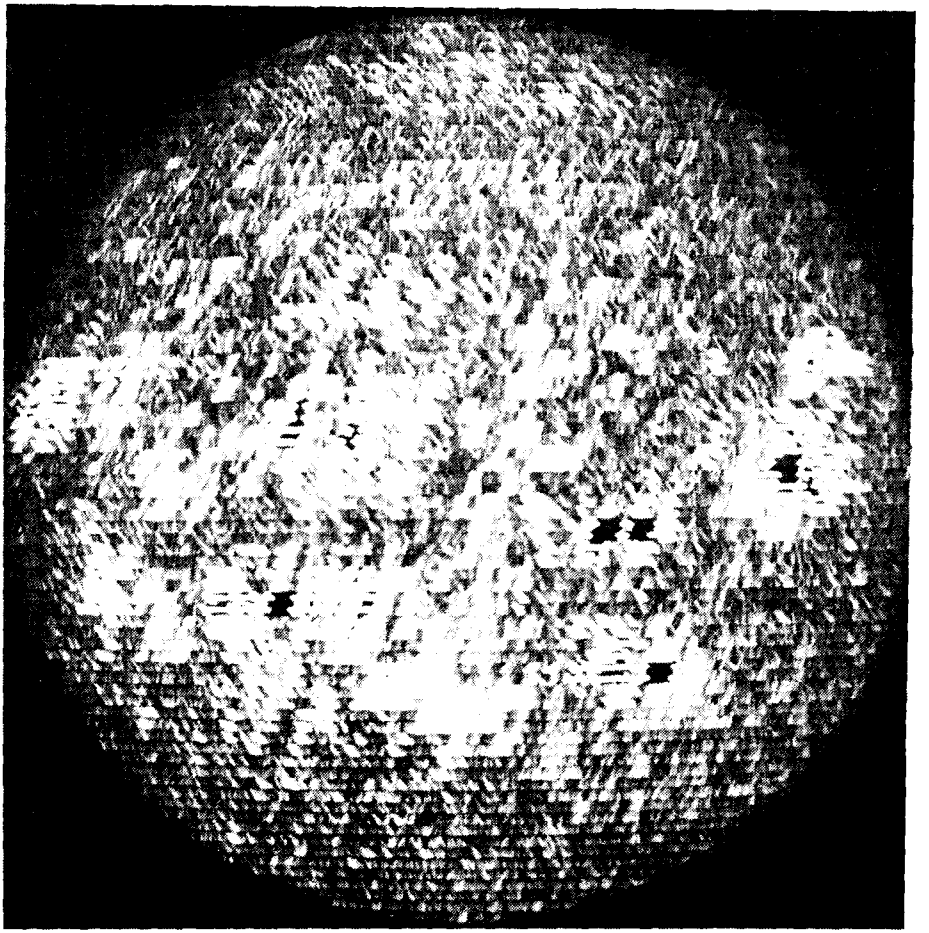

(Mt. Wilson and Mt. Palomar photograph)

gas cascading onto the Sun as it passes through a compression lane. The extra gravitational potential energy released in such a process acts as a heat source near the surface of the star, and according to current ideas and calculations this causes a very slight decrease in the rate of nuclear burning at the center and, most significantly for our purposes, a slight *decrease* in the width of the convection zone. In other words, the star is, if anything, stabilized by the changes. But what happens when the extra source of energy is switched off? Now, looking at these changes in reverse, we expect the convection zone to expand slightly—and that is just the trigger which astrophysicists have long suspected of being sufficient to start a convective instability, with mixing of the deeper layers in the Sun and a temporary switching off of the nuclear burning processes. The trigger is not the submergence of the Sun into the clouds of dust and



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*Fig. 5. Magnetogram showing the intensity and polarity of weak magnetic fields in the Sun's chromosphere, July 21, 1961.*

gas, but its reaction on emerging again into clear space. This happened only a few tens of thousands of years ago, and by all accounts we should expect it to take a good few million years for the Sun to recover its normal equilibrium.

According to McCrea's updating of older ideas, the arrival of dust onto the Sun can actually cause an ice age by making the solar surface a little hotter! This seeming paradox depends on subtleties of the interaction between incoming heat at the Earth's atmosphere and the reflectivity of clouds, ice and snow. Very briefly, it seems that a modest increase in heat arriving would cause equatorial regions to warm more than polar regions, increasing the temperature difference between the two. This encourages strong winds which combine with the increased heat to increase evaporation and produce extensive cloud cover which, when it arrives at high latitudes, brings increased precipitation. Because of the shielding effect of the reflecting clouds, some high latitude regions might even be cooler than before the Sun's output increased, so that the extra precipitation can build up as snow, leading to an ice age. A further warming of the Sun would, of course, be enough to melt the ice and produce more clement conditions, but then as the Sun cooled back to 'normal' after reaching peak luminosity it would again pass through the critical region where ice age conditions could appear on Earth. Erratic increases and decreases in solar output as it passed through a patchy lane of dusty material would certainly produce, on this model, an erratic pattern of ice ages and interglacials, lasting for millions of years, superficially rather like the erratic pattern of the most recent geological record.

There is one big snag with all this, since many climatologists now believe that ice ages are times of *decreased* overall precipitation and, presumably, correspondingly de-

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creased cloud cover. But this is not a universal view, and there is still room for the alternative theory. It's also worth noting that in the 1950s when this theory was described by H. Wexler in the book *Climatic Change* (edited by Shapley) the "first and most important objection" to the hot Sun/cool Earth theory was given as the lack of "evidence observational or theoretical which would account for the Sun's energy output increasing and decreasing significantly in the time intervals required for the explanation of the ice ages." McCrea's theory removes that prime objection—and some very recent work provides yet another hint that the Sun today is not a normal star.

In 1976, three teams of solar observers reported the results of sophisticated new techniques which allowed them for the first time to measure the vibrations of the whole Sun, by watching the edge of the solar disk as it moves. It doesn't move much, of course, but the slight pulsations can be measured and related to the shaking of the Sun like a giant liquid drop. This development is of key importance to studies of the Sun's interior, since in principle such vibrations can be used to study the inside of the Sun in much the same way that earthquakes reveal details of the structure of our planet. And right away a pulsation has been found that doesn't fit with the standard models of a star with the mass and luminosity of the Sun. This vibration, with a period of two hours and forty minutes, is however "quite consistent with the observed absence of any appreciable neutrino flux from the Sun" (in the words of the team that discovered it), and suggests independently of that evidence that the interior of the Sun is about ten percent cooler than it 'ought' to be for a normal star.

The whole thing hangs together so well that it is hard to see how it can now be refuted. Even if you were to throw out the links with ice ages, two independent observational tests now show the same result about the inside of the Sun, incompatible with the simple models of stable stars. And if you do want to throw out the ice age speculations, there is still some more food for thought in smaller, recent climatic changes; not conclusive in themselves, but intriguing if you already suspect the Sun may not be in a normal state today.

As a trained astrophysicist who wandered into climatic research by a side door, I was horrified to discover some of my new climatologist colleagues, without the benefit of specialist training in astronomy, making the seemingly wild assumption that many factors of climatic change over the past few hundred years could be explained by assuming that the amount of heat radiated by the Sun varies by one or two percent over the

*Fig. 6. The Sun as it appears in normal "white" light, with a close-up of a prominent sunspot group.*



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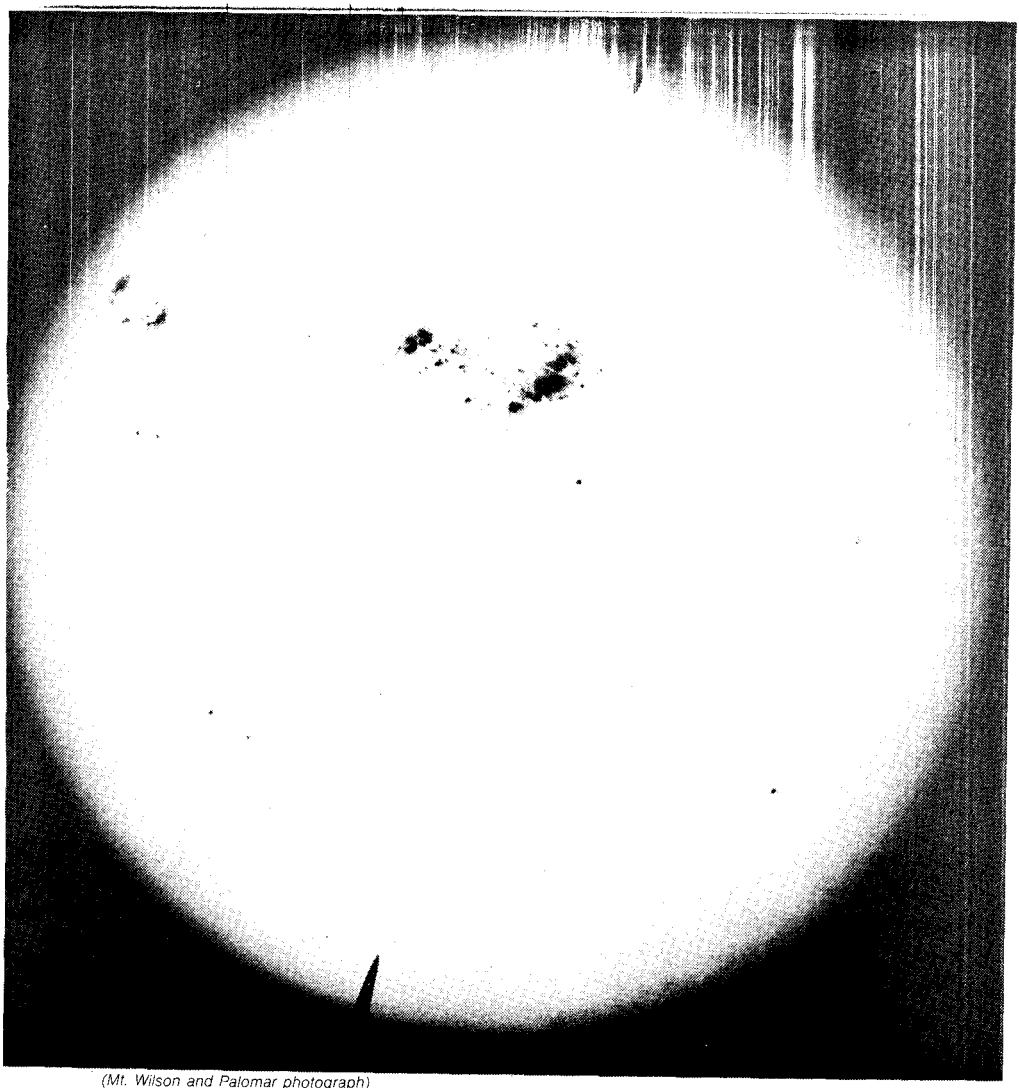

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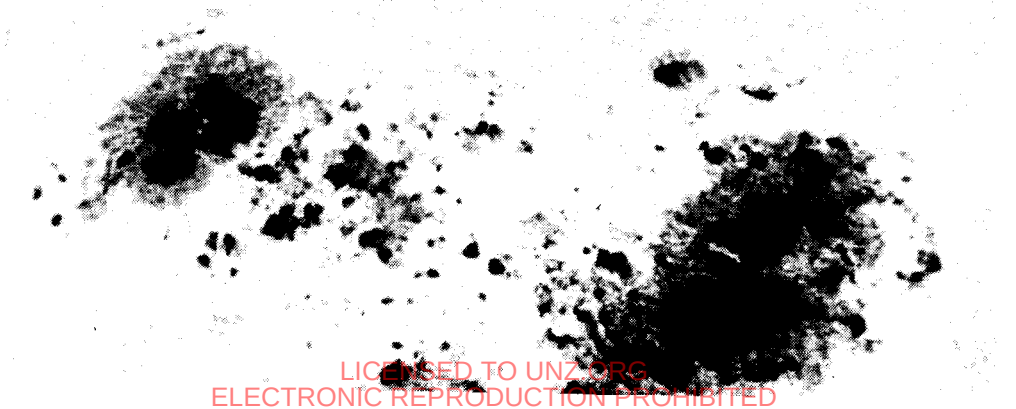

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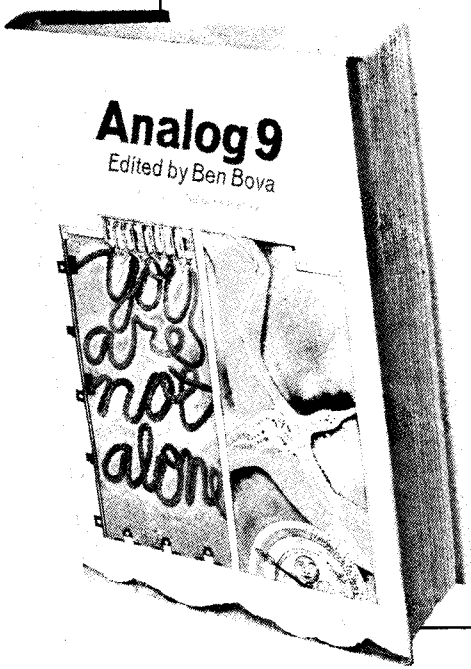


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eleven years or so of the solar cycle. Any elementary astronomy course teaches that stars just do not vary in this way, and observations of many stars which we believe to be like the Sun in terms of mass and age confirm the theory. A two percent variable with an eleven-year cycle has never been found anywhere—how could we overlook one sitting in our astronomical backyard?

Well, it seems we could. Having been first horrified by the climatologists' disregard for astronomical doctrine, I was even more horrified to find when I checked up, that no observation of solar intensity from Earth has been able to measure the solar "constant" (which climatologists now dub the solar "parameter") better than a claimed accuracy of ±1%—and the various experiments disagree with one another by as much as nine percent! What we need is a very accurate satellite-mounted experiment to make some definitive observations of the Sun over a decade or so—but there is no such experiment yet planned, let alone aloft.

The final shock which made me decide those elementary astronomy courses may be wrong after all came in late 1975, when US astronomers announced that a program monitoring the brightness changes of the outer planets showed variations of a couple of percent over the solar cycle of activity. The most widely accepted view of this at present is that some subtle effect of the solar cycle, such as changes in ultraviolet radiation, could produce this effect by stimulating photochemical processes in the clouds of the outer planets which alter their albedos. But the effect could certainly be a genuine modulation of solar output, within the observational limits set so far by ground-based studies. Indeed, with a little imagination the whole business of the eleven-year cycle of solar activity could itself be a manifestation of the Sun being in a disturbed state—we do not understand this cycle and we have no way of knowing if it is a normal thing for stars like the Sun.

As things now stand, the diagnosis seems unambiguous. Our Sun is not a normal star at present, but is decidedly off color. The prognosis is equally clear: left to its own devices, the Sun will make a good recovery within the next thirty million years or so, but is likely to suffer from a recurrence of the symptoms at intervals of about 100 million years associated with passage through spiral arm dust lanes. It may be in the realms of climate that the abnormality of the Sun has most direct relevance to us just now; and the links between ice ages, dust lanes and solar variations may be of even greater relevance to ideas about when and where civilizations other than our own might emerge in our galaxy. Some of these sagas of science fiction may need rewriting!

***Dr. Gribbin*** *is the author of* Our Changing Universe, *published by E.P. Dutton & Co., Inc., New York.*



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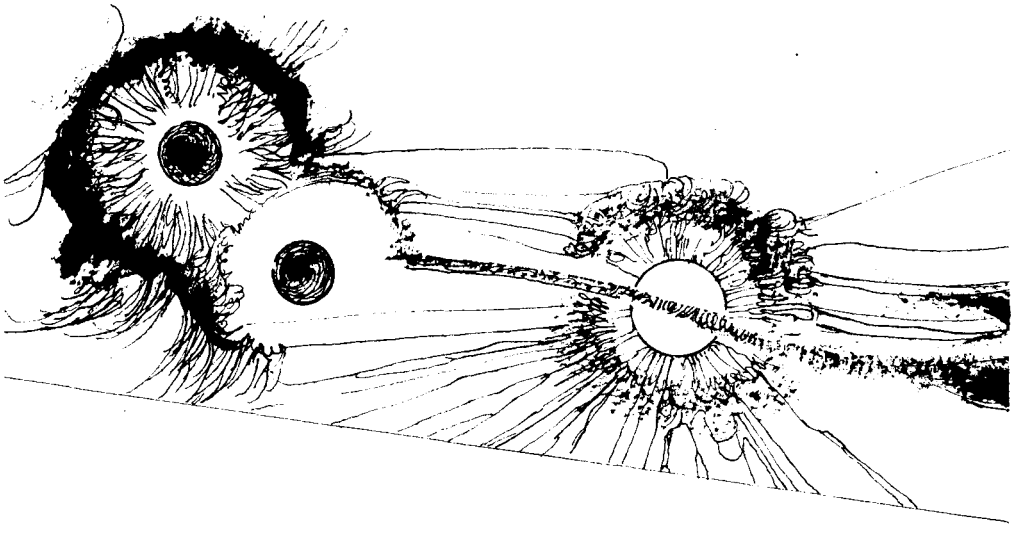

*Every death is the end of a world.*

**Edward Bryant**

# particle theory

I see my shadow flung like black iron against the wall. My sundeck blazes with untimely summer. Eliot was wrong; Frost, right.

Nanoseconds . . .

Death is as relativistic as any other apparent constant. I wonder: *am I dying?*

I thought it was a cliché with no underlying truth.

"Lives *do* flash in a compressed instant before dying eyes," said Amanda. She poured me another glass of burgundy the color of her hair. The fire highlighted both. "A psychologist named Noyes—" She broke off and smiled at me. "You really want to hear this?"

"Sure." The fireplace light softened the taut planes of her face. I saw a flicker of the gentler beauty she had possessed thirty years before.

"Noyes catalogued testimonial evidence for death's-door phenomena in the early seventies. He termed it 'life review,' the second of three

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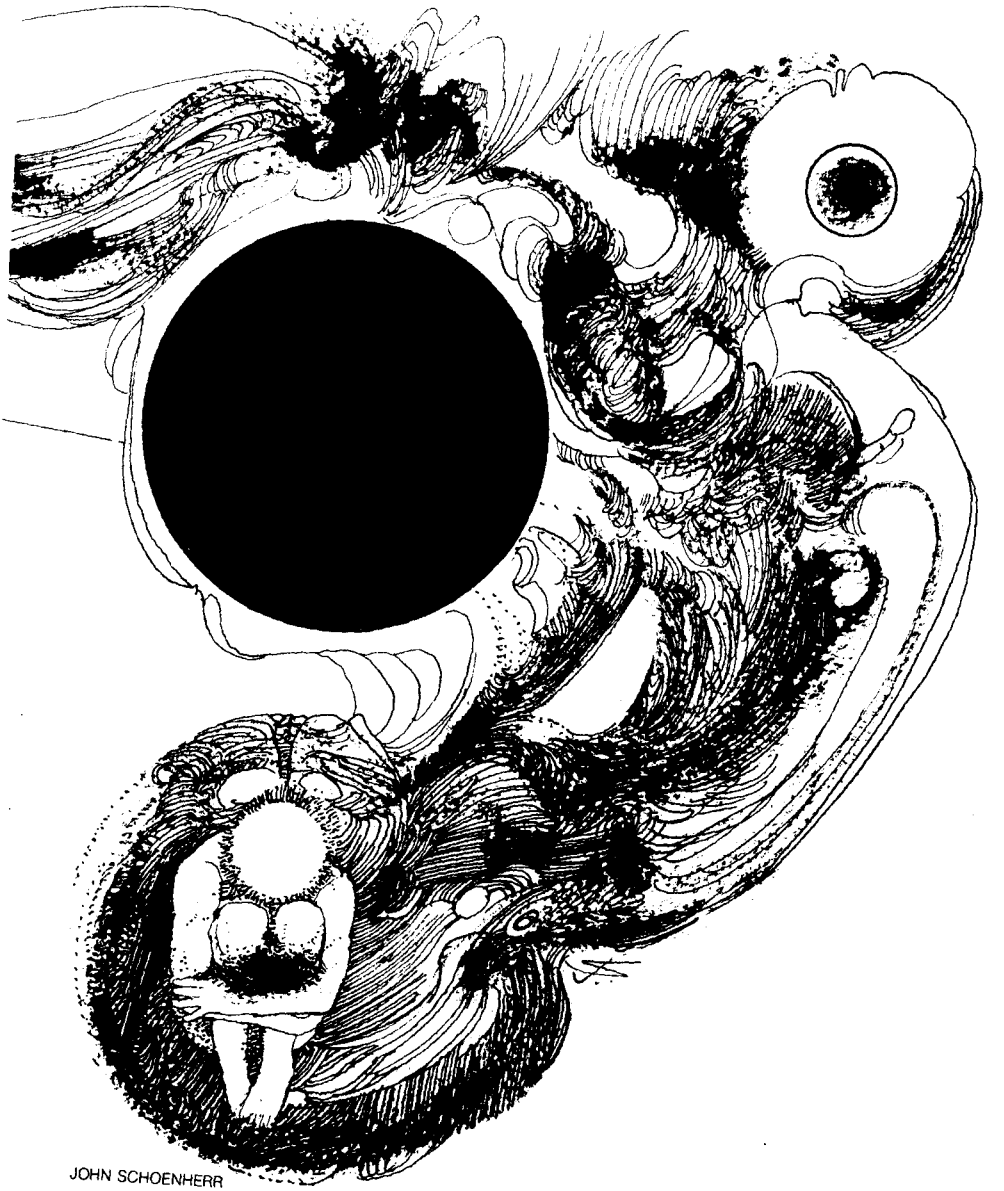

JOHN SCHOENHERR

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clearly definable steps in the process of dying; like a movie, and not necessarily linear."

I drink. I have a low threshold of intoxication, I ramble. "Why does it happen? How?" I didn't like the desperation in my voice. We were suddenly much further apart than the geography of the table separating us; I looked in Amanda's eyes for some memory of Lisa. "Life goes shooting off—or we recede from it—like Earth and an interstellar probe irrevocably severed. Mutual recession at light-speed, and the dark fills in the gap." I held my glass by the stem, rotated it, peered through the distorting bowl.

Pine logs crackled. Amanda turned her head and her eyes' image shattered in the flames.

The glare, the glare—

When I was thirty I made aggrieved noises because I'd screwed around for the past ten years and not accomplished nearly as much as I should. Lisa only laughed, which sent me into a transient rage and a longer-lasting sulk before I realized hers was the only appropriate response.

"Silly, silly," she said. "A watered-down Byronic character, full of self-pity and sloppy self-adulation." She blocked my exit from the kitchen and said millimeters from my face, "It's not as though you're waking up at thirty to discover that only fifty-six people have heard of you."

I stuttered over a weak retort.

"Fifty-seven?" She laughed; I laughed.

Then I was forty and went through the same pseudo-menopausal trauma. Admittedly, I hadn't done any work at all for nearly a year, and any *good* work for two. Lisa didn't laugh this time; she did what she could, which was mainly to stay out of my way while I alternately moped and raged around the coast house southwest of Portland. Royalties from the book I'd done on the fusion breakthrough kept us in groceries and mortgage payments.

"Listen, maybe if I'd go away for a while—" she said. "Maybe it would help for you to be alone." Temporary separations weren't alien to our marriage; we'd once figured that our relationship got measurably rockier if we spent more than about sixty percent of our time together. It had been a long winter and we were overdue; but then Lisa looked intently at my face and decided not to leave. Two months later I worked through the problems in my skull, and asked her for solitude. She knew me well—well enough to laugh again because she knew I was waking out of another mental hibernation.

She got onto a jetliner on a gray winter day and headed east for my parents' old place in southern Colorado. The jetway for the flight was out of commission that afternoon, so the airline people had to roll out one of the old wheeled stairways. Just before she stepped into the cabin,



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Lisa paused and waved back from the head of the stairs; her dark hair curled about her face in the wind.

Two months later I'd roughed out most of the first draft for my initial book about the reproductive revolution. At least once a week I would call Lisa and she'd tell me about the photos she was taking river-running on an icy Colorado or Platte. Then I'd use her as a sounding board for speculations about ectogenesis, heterogynes, or the imminent emergence of an exploited human host-mother class.

"So what'll we do when you finish the first draft, Nick?"

"Maybe we'll take a leisurely month on the Trans-Canadian Railroad."

"Spring in the provinces . . ."

Then the initial draft was completed and so was Lisa's Colorado adventure. "Do you know how badly I want to see you?" she said.

"Almost as badly as I want to see you."

"Oh, no," she said. "Let me tell you—"

What she told me no doubt violated state and federal laws and probably telephone company tariffs as well. The frustration of only hearing her voice through the wire made me twine my legs like a contortionist.

"Nick, I'll book a flight out of Denver. I'll let you know."

I think she wanted to surprise me. Lisa didn't tell me when she booked the flight. The airline let me know.

---

And now I'm fifty-one. The pendulum has swung and I again bitterly resent not having achieved more. There is so much work left undone; should I live for centuries, I still could not complete it all. That, however, will not be a problem.

I am told that the goddamned level of acid phosphatase in my goddamned blood is elevated. How banal that single fact sounds, how sterile; and how self-pitying the phraseology. Can't I afford a luxurious tear, Lisa?

Lisa?

Death: I wish to determine my own time.

"Charming," I said much later. "End of the world."

My friend Denton, the young radio astronomer, said, "Christ almighty! Your damned jokes. How can you make a pun about this?"

"It keeps me from crying," I said quietly. "Wailing and breast-beating won't make a difference."

"Calm, so calm." She looked at me peculiarly.

"I've seen the enemy," I said. "I've had time to consider it."

Her face was thoughtful, eyes focused somewhere beyond this cluttered office. "*If* you're right," she said, "it could be the most fantastic event a scientist could observe and record." Her eyes refocused and met mine. "Or it might be the most frightening; a final horror."

"Choose one," I said.



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"If I believed you at all."

"I'm dealing in speculations."

"Fantasies," she said.

"However you want to term it." I got up and moved to the door. "I don't think there's much time. You've never seen where I live. Come—" I hesitated, "—visit me if you care to. I'd like that—to have you there."

"Maybe," she said.

I should not have left the situation ambiguous.

I didn't know that in another hour, after I had left her office, pulled my car out of the Gamow Peak parking lot and driven down to the valley, Denton would settle herself behind the wheel of her sports car and gun it onto the Peak road. Tourists saw her go off the switchback. A Highway Department crew pried her loose from the embrace of Lotus and lodgepole.

When I got the news I grieved for her, wondering if this were the price of belief. I drove to the hospital and, because no next of kin had been found and Amanda intervened, the doctors let me stand beside the bed.

I had never seen such still features, never such stasis short of actual death. I waited an hour, seconds sweeping silently from the wall clock, until the urge to return home was overpowering.

I could wait no longer because daylight was coming and I would tell no one.

Toward the beginning:

I've tolerated doctors as individuals; as a class they terrify me. It's a dread like shark attacks or dying by fire. But eventually I made the appointment for an examination, drove to the sparkling white clinic on the appointed day and spent a surly half hour reading a year-old issue of *Popular Science* in the waiting room.

"Mr. Richmond?" the smiling nurse finally said. I followed her back to the examination room. "Doctor will be here in just a minute." She left. I sat apprehensively on the edge of the examination table. After two minutes I heard the rustling of my file being removed from the outside rack. Then the door opened.

"How's it going?" said my doctor. "I haven't seen you in a while."

"Can't complain," I said, reverting to accustomed medical ritual. "No flu so far this winter. The shot must have been soon enough."

Amanda watched me patiently. "You're not a hypochondriac. You don't need continual reassurance—or sleeping pills, any more. You're not a medical groupie, God knows. So what is it?"

"Uh," I said. I spread my hands helplessly.

"Nicholas." Get-on-with-it-I'm-busy-today sharpness edged her voice.

"Don't imitate my maiden aunt."

"All right, *Nick*," she said. "What's wrong?"

"I'm having trouble urinating."



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She jotted something down. Without looking up, "What kind of trouble?"

"Straining."

"For how long?"

"Six, maybe seven months. It's been a gradual thing."

"Anything else you've noticed?"

"Increased frequency."

"That's all?"

"Well," I said, "afterwards. I, uh, dribble."

She listed, as though by rote: "Pain, burning, urgency, hesitancy, change in stream of urine? Incontinence, change in size of stream, change in appearance of urine?"

"What?"

"Darker, lighter, cloudy, blood discharge from penis, VD exposure, fever, night sweats?"

I answered with a variety of nods or monosyllables.

"Mmh." She continued to write on the pad, then snapped it shut. "Okay, Nick, would you get your clothes off?" And when I had stripped, "Please lie on the table. On your stomach."

"The greased finger?" I said. "Oh shit."

Amanda tore a disposable glove off the roll. It crackled as she put it on. "You think I get a thrill out of this?" She's been my GP for a long time.

When it was over and I sat gingerly and uncomfortably on the edge of the examining table, I said, "Well?"

Amanda again scribbled on a sheet. "I'm sending you to a urologist. He's just a couple of blocks away. I'll phone over. Try to get an appointment in—oh, inside of a week."

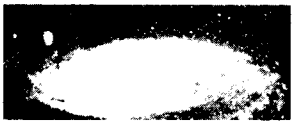
"Give me something better," I said, "or I'll go to the library and check out a handbook of symptoms."

She met my eyes with a candid blue gaze. "I want a specialist to check out the obstruction."

"You found something when you stuck your finger in?"

"Crude, Nicholas." She half smiled. "Your prostate is hard—stony. There could be a number of reasons."

"What John Wayne used to call the Big C?"

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"Prostatic cancer," she said, "is relatively infrequent in a man of your age." She glanced down at my records. "Fifty."

"Fifty-one," I said, wanting to shift the tone, trying, failing. "You didn't send me a card on my birthday."

"But it's not impossible," Amanda said. She stood. "Come on up to the front desk. I want an appointment with you after the urology results come back." As always, she patted me on the shoulder as she followed me out of the examination room. But this time there was slightly too much tension in her fingers.

I was seeing grassy hummocks and marble slabs in my mind and didn't pay attention to my surroundings as I exited the waiting room.

"Nick?" A soft Oklahoma accent.

I turned back from the outer door, looked down, saw tousled hair. Jackie Denton, one of the bright young minds out at the Gamow Peak Observatory, held the well-thumbed copy of *Popular Science* loosely in her lap. She honked and snuffled into a deteriorating Kleenex. "Don't get too close. Probably doesn't matter at this point. Flu. You?" Her green irises were red-rimmed.

I fluttered my hands vaguely. "I had my shots."

"Yeah." She snuffled again. "I was going to call you later on from work. See the show last night?"

I must have looked blank.

"Some science writer," she said. "Rigel went supernova."

"Supernova," I repeated stupidly.

"Blam, you know? *Blooie*." She illustrated with her hands and the magazine flipped onto the carpet. "Not that you missed anything. It'll be around for a few weeks—biggest show in the skies."

A sudden ugly image of red-and-white aircraft warning lights merging in an actinic flare sprayed my retinas. I shook my head. After a moment I said, "First one in our galaxy in—how long? Three hundred and fifty years? I wish you'd called me."

"A little longer. Kepler's star was in 1604. Sorry about not calling—we were all a little busy, you know?"

"I can imagine. When did it happen?"

She bent to retrieve the magazine. "Just about midnight. Spooky. I was just coming off shift." She smiled. "Nothing like a little cosmic cataclysm to take my mind off jammed sinuses. Just as well; no sick leave tonight. That's why I'm here at the clinic. Kris says no excuses."

Krishnamurthi was the Gamov director. "You'll be going back up to the peak soon?" She nodded. "Tell Kris I'll be in to visit. I want to pick up a lot of material."

"For sure."

The nurse walked up to us. "Ms. Denton?"

"Mmph." She nodded and wiped her nose a final time. Struggling up from the soft chair, she said, "How come you didn't read about Rigel in the papers? It made every morning edition."



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"I let my subscriptions lapse."

"But the TV news? The radio?"

"I didn't watch, and I don't have a radio in the car."

Before disappearing into the corridor to the examination rooms, she said, "That country house of yours must really be isolated."

The ice drips from the eaves as I drive up and park beside the garage. Unless the sky deceives me there is no new weather front moving in yet; no need to protect the car from another ten centimeters of fresh snow.

Sunset comes sooner at my house among the mountains; shadows stalk across the barren yard and suck heat from my skin. The peaks are, of course, deliberate barriers blocking off light and warmth from the coastal cities. Once I personified them as friendly giants, amiable *lummoxen* guarding us. No more. Now they are only mountains again, the Cascade Range.

For an instant I think I see a light flash on, but it is just a quick sunset reflection on a window. The house remains dark and silent. The poet from Seattle's been gone for three months. My coldness—her heat. I thought that transference would warm me. Instead she chilled. The note she left me in the vacant house was a sonnet about psychic frostbite.

My last eleven years have not been celibate, but sometimes they feel like it. Entropy ultimately overcomes all kinetic force.

Then I looked toward the twilight east and saw Rigel rising. Luna wouldn't be visible for a while, so the brightest object in the sky was the exploded star. It fixed me to this spot by my car with the intensity of an aircraft landing light. The white light that shone down on me had left the supernova five hundred years before (a detail to include in the inevitable article—a graphic illustration of interstellar distances never fails to awe readers).

Tonight, watching the 100 billion-degree baleful eye that was Rigel convulsed, I know *I* was awed. The cataclysm glared, brighter than any planet. I wondered whether Rigel—unlikely, I knew—had had a planetary system; whether guttering mountain ranges and boiling seas had preceded worlds frying. I wondered whether, five centuries before, intelligent beings had watched stunned as the stellar fire engulfed their skies. Had they time to rail at the injustice? There are 100 billion stars in our galaxy; only an estimated three stars go supernova per thousand years. Good odds: Rigel lost.

Almost hypnotized, I watched until I was abruptly rocked by the wind rising in the darkness. My fingers were stiff with cold. But as I started to enter the house I looked at the sky a final time. Terrifying Rigel, yes—but my eyes were captured by another phenomenon in the north. A spark of light burned brighter than



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the surrounding stars. At first I thought it was a passing aircraft, but its position remained stationary. Gradually, knowing the odds and unwilling to believe, I recognized the new supernova for what it was.

In five decades I've seen many things. Yet watching the sky I felt like I was a primitive, shivering in uncured furs. My teeth chattered from more than the cold. I wanted to hide from the universe. The door to my house was unlocked, which was lucky—I couldn't have fitted a key into the latch. Finally I stepped over the threshold. I turned on all the lights, denying the two stellar pyres burning in the sky.

My urologist turned out to be a dour black man named Sharpe who treated me, I suspected, like any of the other specimens that turned up in his laboratory. In his early thirties, he'd read several of my books. I appreciated his having absolutely no respect for his elders or for celebrities.

"You'll give me straight answers?" I said.

"Count on it."

He also gave me another of those damned urological fingers. When I was finally in a position to look back at him questioningly, he nodded slowly and said, "There's a nodule."

Then I got a series of blood tests for an enzyme called acid phosphatase. "Elevated," Sharpe said.

Finally, at the lab, I was to get the cystoscope, a shiny metal tube which would be run up my urethra. The biopsy forceps would be inserted through it. "Jesus, you're kidding." Sharpe shook his head. I said, "If the biopsy shows a malignancy . . ."

"I can't answer a silence."

"Come on," I said. "You've been straight until now. What are the chances of curing a malignancy?"

Sharpe had looked unhappy ever since I'd walked into his office. Now he looked unhappier. "Ain't my department," he said. "Depends on many factors."

"Just give me a simple figure."

"Maybe thirty percent. All bets are off if there's a metastasis." He met my eyes while he said that, then busied himself with the cystoscope. Local anesthetic or not, my penis burned like hell.

I had finally gotten through to Jackie Denton on a private line the night of the second supernova. "I thought last night was a madhouse," she said. "You should see us now. I've only got a minute."

"I just wanted to confirm what I was looking at," I said. "I saw the damn thing actually blow."

"You're ahead of everybody at Gamow. We were busily focusing on Rigel—" Electronic *wheeps* garbled the connection. "Nick, are you still there?"

"I think somebody wants the line. Just tell me a final thing: is it a full-fledged supernova?"

"Absolutely. As far as we can



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determine now, it's a genuine Type II."

"Sorry it couldn't be the biggest and best of all."

"Big enough," she sid. "It's good enough. This time it's only about nine light-years away. Sirius A."

"Eight point seven light-years," I said automatically. "What's that going to mean?"

"Direct effects? Don't know. We're thinking about it." It sounded like her hand cupped the mouthpiece; then she came back on the line. "Listen, I've got to go. Kris is screaming for my head. Talk to you later."

"All right," I said. The connection broke. On the dead line I thought I heard the 21-centimeter basic hydrogen hiss of the universe. Then the dial tone cut in and I hung up the receiver.

Amanda did not look at all happy. She riffled twice through what I guessed were my laboratory test results. "All right," I said from the patient's side of the wide walnut desk. "Tell me."

*"Mr. Richmond? Nicholas Richmond?"*

*"Speaking."*

*"This is Mrs. Kurnick, with Trans-West Airways. I'm calling from Denver."*

*"Yes?"*

*"We obtained this number from a charge slip. A ticket was issued to Lisa Richmond—"*

*"My wife. I've been expecting her sometime this weekend. Did she ask you to phone ahead?"*

*"Mr. Richmond, that's not it. Our manifest shows your wife boarded our Flight 903, Denver to Portland, tonight."*

*"So? What is it? What's wrong? Is she sick?"*

*"I'm afraid there's been an accident."*

*Silence choked me. "How bad?" The freezing began.*

*"Our craft went down about ten miles northwest of Glenwood Springs, Colorado. The ground parties at the site say there are no survivors. I'm sorry, Mr. Richmond."*

*"No one?" I said, "I mean—"*

*"I'm truly sorry," said Mrs. Kurnick. "If there's any change in the situation, we will be in touch immediately."*

*Automatically I said, "Thank you."*

*I had the impression that Mrs. Kurnick wanted to say something else; but after a pause, she only said, "Good night."*

*On a snowy Colorado mountainside I died.*

"The biopsy was malignant," Amanda said.

"Well," I said. "That's pretty bad." She nodded. "Tell me about my alternatives." *Ragged bits of metal slammed into the mountainside like teeth.*

My case was unusual only in a relative sense. Amanda told me that prostatic cancer is the penalty men



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pay for otherwise good health. If they avoid every other health hazard, twentieth-century men eventually get zapped by their prostates. In my case, the problem was about twenty years early; my bad luck. *Cooling metal snapped and sizzled in the snow, was silent.*

Assuming that the cancer hadn't already metastasized, there were several possibilities; but Amanda had, at this stage, little hope for either radiology or chemotherapy. She suggested a radical prostatectomy.

"I wouldn't suggest it if you didn't have a hell of a lot of valuable years left," she said. "It's not usually advised for older patients. But you're in generally good condition; you could handle it."

*Nothing moved on the mountainside.* "What all would come out?" I said.

"You already know the ramifications of 'radical'."

I didn't mind so much the ligation of the spermatic tubes—I should have done that a long time before. At fifty-one I could handle sterilization with equanimity, but—

"Sexually dysfunctional?" I said. "Oh my God." I was aware of my voice starting to tighten. "I can't do that."

"You sure as hell can," said Amanda firmly. "How long have I known you?" She answered her own question. "A long time. I know you well enough to know that what counts isn't all tied up in your penis."

I shook my head silently.

"Listen, damn it, cancer death is worse."

"No," I said stubbornly. "Maybe. Is that the whole bill?"

It wasn't. Amanda reached my bladder's entry on the list. It would be excised as well.

"Tubes protruding from me?" I said. "*If* I live, I'll have to spend the rest of my life toting a plastic bag as a drain for my urine?"

Quietly she said, "You're making it too melodramatic."

"But am I right?"

After a pause, "Essentially, yes."

And all that was the essence of it; the *good* news, all assuming that the carcinoma cells wouldn't jar loose during surgery and migrate off to other organs. "No," I said. The goddamned lousy, loathsome unfairness of it all slammed home. "Goddamn it, no. It's my choice; I won't live that way. If I just die, I'll be done with it."

"Nicholas! Cut the self-pity."

"Don't you think I'm entitled to some?"

"Be reasonable."

"You're supposed to comfort me," I said. "Not argue. You've taken all those death-and-dying courses. *You* be reasonable."

The muscles tightened around her mouth. "I'm giving you suggestions," said Amanda. "You can do with them as you damned well please." It had been years since I'd seen her angry.

We glared at each other for close



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to a minute. "Okay," I said. "I'm sorry."

She was not mollified. "Stay upset, even if it's whining. Get angry, be furious. I've watched you in a deep-freeze for a decade."

I recoiled internally. "I've survived. That's enough."

"No way. You've been sitting around for eleven years in suspended animation, waiting for someone to chip you free of the glacier. You've let people carom past, occasionally bouncing off you with no effect. Well, now it's not some*one* that's shoving you to the wall—it's some*thing*. Are you going to lie down for it? Lisa wouldn't have wanted that."

"Leave her out," I said.

"I can't. You're even more important to me because of her. She was my closest friend, remember?"

*"Pay attention to her," Lisa had once said. "She's more sensible than either of us." Lisa had known about the affair; after all, Amanda had introduced us.*

"I know." I felt disoriented; denial, resentment, numbness—the roller coaster clattered toward a final plunge.

"Nick, you've got a possibility for a healthy chunk of life left. I want you to have it, and if it takes using Lisa as a wedge, I will."

"I don't want to survive if it means crawling around as a piss-dripping cyborg eunuch." The roller coaster teetered on the brink.

Amanda regarded me for a long moment, then said earnestly, "There's an outside chance, a long-shot. I heard from a friend there that the New Mexico Meson Physics Facility is scouting for a subject."

I scoured my memory. "Particle beam therapy?"

"Pions."

"It's chancy," I said.

"Are you arguing?" She smiled.

I smiled too. "No."

"Want to give it a try?"

My smile died. "I don't know. I'll think about it."

"That's encouragement enough," said Amanda. "I'll make some calls and see if the facility's as interested in you as I expect you'll be in them. Stick around home? I'll let you know."

"I haven't said 'yes'. We'll let each other know." I didn't tell Amanda, but I left her office thinking only of death.

Melodramatic as it may sound, I went downtown to visit the hardware stores and look at their displays of pistols. After two hours, I tired of handling weapons. The steel seemed uniformly cold and distant.

When I returned home late that afternoon, there was a single message on my phone-answering machine:

"Nick, this is Jackie Denton. Sorry I haven't called for a while, but you know how it's been. I thought you'd like to know that Kris is going to have a press conference early in the week—probably Monday afternoon. I think he's worried because he hasn't come up with a good theory to cover



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the three Type II supernovas and the half-dozen standard novas that have occurred in the last few weeks. But then nobody I know has. We're all spending so much time awake nights, we're turning into vampires. I'll get back to you when I know the exact time of the conference. I think it must be about thirty seconds now, so I—" The tape ended.

I mused with winter bonfires in my mind as the machine rewound and reset. Three Type II supernovas? One is merely nature, I paraphrased. Two mean only coincidence. Three make a conspiracy.

Impulsively I slowly dialed Denton's home number; there was no answer. Then the lines to Gamow Peak were all busy. It seemed logical to me that I needed Jackie Denton for more than being my sounding board, or for merely news about the press conference. I needed an extension of her friendship. I thought I'd like to borrow the magnum pistol I knew she kept in a locked desk drawer at her observatory office. I knew I could ask her a favor. She ordinarily used the pistol to blast targets on the peak's rocky flanks after work.

The irritating regularity of the busy signal brought me back to sanity. Just a second, I told myself. Richmond, what the hell are you proposing?

Nothing, was the answer. Not yet. Not . . . quite.

Later in the night, I opened the sliding glass door and disturbed the skiff of snow on the second-story deck. I shamelessly allowed myself the luxury of leaving the door partially open so that warm air would spill out around me while I watched the sky. The stars were intermittently visible between the towering banks of stratocumulus scudding over the Cascades. Even so, the three supernovas dominated the night. I drew imaginary lines with my eyes; connect the dots and solve the puzzle. How many enigmas can you find in this picture?

I reluctantly took my eyes away from the headline phenomena and searched for old standbys. I picked out the red dot of Mars.

Several years ago I'd had a cockamamie scheme that sent me to a Mesmerist—that's how she'd billed herself—down in Eugene. I'd been driving up the coast after covering an aerospace medical conference in Oakland. Somewhere around Crescent City, I capped a sea-bass dinner by getting blasted on prescribed pills and proscribed Scotch. Sometime during the evening, I remembered the computer-enhancement process JPL had used to sharpen the clarity of telemetered photos from such projects as the Mariner fly-bys and the Viking Mars lander. It seemed logical to me at the time that memories from the human computer could somehow be enhanced, brought into clarity through hypnosis. Truly stoned fantasies. But they somehow sufficed as rationale and incentive to



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wind up at Madame Guzmann's "Advice/Mesmerism/Health" establishment across the border in Oregon. Madame Guzmann had skin the color of her stained hardwood door; she made a point of looking and dressing the part of a stereotype we *gajos* would think of as Gypsy. The scarf and crystal ball strained the image. I think she was Vietnamese. At any rate she convinced me she could hypnotize. and then she nudged me back through time.

*Just before she ducked into the cabin, Lisa paused and waved back from the head of the stairs; her dark hair curled about her face in the wind.*

I should have taken to heart the lesson of stasis; entropy is not so easily overcome.

What Madame Guzmann achieved was to freeze-frame that last image of Lisa. Then she zoomed me in so close it was like standing beside Lisa. I sometimes still see it in my nightmares: Her eyes focus distantly. Her skin has the graininess of a newspaper photo. I look but cannot touch. I can speak but she will not answer. I shiver with the cold—

—and slid the glass door further open.

There! An eye opened in space. A glare burned as cold as a refrigerator light in a night kitchen. Mars seemed to disappear, swallowed in the glow from the nova distantly behind it. Another one, I thought. The new eye held me fascinated, pinned as securely as a child might fasten a new moth in the collection.

*Nick?*

Who is it?

*Nick . . .*

You're an auditory hallucination.

There on the deck the sound of laughter spiraled around me. I thought it would shake loose the snow from the trees. The mountain stillness vibrated.

*The secret, Nick.*

What secret?

*You're old enough at fifty-one to decipher it.*

Don't play with me.

*Who's playing? Whatever time is left—*

Yes?

*You've spent eleven years now dreaming, drifting, letting others act on you.*

I know.

*Do you? Then act on* that. *Choose your actions. No lover can tell you more. Whatever time is left—*

Shivering uncontrollably, I gripped the rail of the deck. A fleeting, pointillist portrait in black and white dissolved into the trees. From branch to branch, top bough to bottom, crusted snow broke and fell, gathering momentum. The trees shed their mantle. Powder swirled up to the deck and touched my face with stinging diamonds.

Eleven years was more than half what Rip van Winkle slept. "Damn it," I said. "Damn you." We prize our sleep. The grave rested peacefully among the trees. "Damn you," I



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said again, looking up at the sky.

On a snowy Oregon mountainside I was no longer dead.

And yes, Amanda. Yes.

After changing planes at Albuquerque, we flew into Los Alamos on a small feeder line called Ross Airlines. I'd never flown before on so ancient a DeHavilland Twin Otter, and I hoped never to again; I'd take a Greyhound out of Los Alamos first. The flight attendant and half the other sixteen passengers were throwing up in the turbulence as we approached the mountains. I hadn't expected the mountains. I'd assumed Los Alamos would lie in the same sort of southwestern scrub desert surrounding Albuquerque. Instead I found a small city nestled a couple of kilometers up a wooded mountainside.

The pilot's unruffled voice came on the cabin intercom to announce our imminent landing, the airport temperature, and the fact that Los Alamos has more Ph.D.'s per capita than any other American city. "Second only to Akademgorodok," I said, turning away from the window toward Amanda. The skin wrinkled around her closed eyes. She hadn't had to use her airsick bag. I had a feeling that despite old friendships, a colleague and husband who was willing to oversee the clinic, the urgency of helping a patient, and the desire to observe the exotic experiment, Amanda might be regretting accompanying me to what she'd termed "the meson factory."

The Twin Otter made a landing approach like a strafing run and then we were down. As we taxied across the apron I had a sudden sensation of déjà vu: the time a year ago when a friend had flown me north in a Cessna. The airport in Los Alamos looked much like the civil air terminal at Sea-Tac where I'd met the Seattle poet. It happened that we were both in line at the snack counter. I'd commented on her elaborate Haida-styled medallion. We took the same table and talked; it turned out she'd heard of me.

"I really admire your stuff," she said.

So much for my ideal poet using only precise images. Wry thought. She was—is—a first-rate poet. I rarely think of her as anything but "the poet from Seattle." Is that kind of depersonalization a symptom?

Amanda opened her eyes, smiled wanly, said, "I could use a doctor." The flight attendant cracked the door and thin New Mexican mountain air revived us both.

Most of the New Mexico Meson Physics Facility was buried beneath a mountain ridge. Being guest journalist as well as experimental subject, I think we were given a more exhaustive tour than would be offered most patients and their doctors. Everything I saw made me think of expensive sets for vintage science fiction movies: the interior of the main accelerator ring, glowing eggshell



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white and curving away like the space-station corridors in *2001*; the linac and booster areas; the straight-away tunnel to the meson medical channel; the five-meter bubble chamber looking like some sort of time machine.

I'd visited both FermiLab in Illinois and CERN in Geneva, so I had a general idea of what the facilities were all about. Still I had a difficult time trying to explain to Amanda the *Alice in Wonderland* mazes that constituted high energy particle physics. But then so did Delaney, the young woman who was the liaison biophysicist for my treatment. It became difficult sorting out the mesons, pions, hadrons, leptons, baryons, J's, fermions and quarks, and such quantum qualities as strangeness, color, baryonness and charm. Especially charm, that ephemeral quality accounting for why certain types of radioactive decay should happen, but don't. I finally bogged down in the midst of quarks, antiquarks, charmed quarks, neo-quarks and quarklets.

Some wag had set a sign on the visitors' reception desk in the administration center reading: "Charmed to meet you." "It's a joke, right?" said Amanda tentatively.

"It probably won't get any funnier," I said.

Delaney, who seemed to load every word with deadly earnestness, didn't laugh at all. "Some of the technicians think it's funny. I don't."

We rehashed the coming treatment endlessly. Optimistically I took notes for the book: *The primary problem with a radiological approach to the treatment of cancer is that hard radiation not only kills the cancerous cells, it also irradiates the surrounding healthy tissue. But in the mid-nineteen seventies, cancer researchers found a more promising tool: shaped beams of subatomic particles which can be selectively focused on the tissue of tumors.*

Delaney had perhaps two decades on Amanda; being younger seemed to give her a perverse satisfaction in playing the pedagogue. "Split atomic nuclei on a small scale–"

"Small?" said Amanda innocently.

"–smaller than a fission bomb. Much of the binding force of the nucleus is miraculously transmuted to matter."

"Miraculously?" said Amanda. I looked up at her from the easy cushion shot I was trying to line up on the green velvet. The three of us were playing rotation in the billiards annex of the NMMPF recreation lounge.

"Uh," said Delaney, the rhythm of her lecture broken. "Physics shorthand."

"Reality shorthand," I said, not looking up from the cue now. "Miracles are as exact a quality as charm."

Amanda chuckled. "That's all I wanted to know."

The miracle pertinent to my case



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was atomic glue, mesons, one of the fission-formed particles. More specifically, my miracle was the negatively charged pion, a subclass of meson. Electromagnetic fields could focus pions into a controllable beam and fire it into a particular target— me.

"There are no miracles in physics," said Delaney seriously. "I used the wrong term."

I missed my shot. A gentle stroke, and gently the cue ball rolled into the corner pocket, missing the eleven. I'd set things up nicely, if accidentally, for Amanda.

She assayed the table and smiled. "Don't come unglued."

"That's very good," I said. Atomic glue does become unstuck, thanks to pions' unique quality. When they collide and are captured by the nucleus of another atom, they reconvert to pure energy; a tiny nuclear explosion.

Amanda missed her shot too. The corners of Delaney's mouth curled in a small gesture of satisfaction. She leaned across the table, hands utterly steady. "Multiply pions, multiply target nuclei, and you have a controlled aggregate explosion releasing considerably more energy than the entering pion beam. *Hah!*"

She sank the eleven and twelve; then ran the table. Amanda and I exchanged glances. "Rack 'em up," said Delaney.

"Your turn," Amanda said to me.

In my case the NMMPF medical channel would fire a directed pion beam into my recalcitrant prostate. If all went as planned, the pions intercepting the atomic nuclei of my cancer cells would convert back into energy in a series of atomic flares. The cancer cells being more sensitive, tissue damage should be restricted, localized in my carcinogenic nodule.

Thinking of myself as a nuclear battlefield in miniature was wondrous. Thinking of myself as a new Stagg Field or an Oak Ridge was ridiculous.

Delaney turned out to be a pool shark *par excellence.* Winning was all-important and she won every time. I decided to interpret that as a positive omen.

"It's time," Amanda said.

"You needn't sound as though you're leading a condemned man to the electric chair." I tied the white medical smock securely about me, pulled on the slippers.

"I'm sorry. Are you worried?"

"Not so long as Delaney counts me as part of the effort toward a Nobel Prize."

"She's good." Her voice rang too hollow in the sterile tiled room. We walked together into the corridor.

"Me, I'm bucking for a Kalinga Prize," I said.

Amanda shook her head. Cloudy hair played about her face. "I'll just settle for a positive prognosis for my patient." Beyond the door, Delaney and two technicians with a gurney waited for me.



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There is a state beyond indignity that defines being draped naked on my belly over a bench arrangement, with my rear spread and facing the medical channel. Rigidly clamped, a ceramic target tube opened a separate channel through my anus to the prostate. Monitoring equipment and shielding shut me in. I felt hot and vastly uncomfortable. Amanda had shot me full of chemicals, not all of whose names I'd recognized. Now dazed, I couldn't decide which of many discomforts was the most irritating.

"Good luck," Amanda had said. "It'll be over before you know it." I'd felt a gentle pat on my flank.

I thought I heard the phasing-up whine of electrical equipment. I could tell my mind was closing down for the duration; I couldn't even remember how many billion electron-volts were about to route a pion beam up my backside. I heard sounds I couldn't identify; perhaps an enormous metal door grinding shut.

My brain swam free in a chemical river; I waited for something to happen.

*I thought I heard machined ball bearings rattling down a chute; no, particles screaming past the giant bending magnets into the medical channel at 300,000 kilometers per second; flashing toward me through the series of adjustable filters; slowing, slowing, losing energy as they approach; then through the final tube and into my body. Inside . . .*

*The pion sails the inner atomic seas for a relativistically finite time. Then the perspective inhabited by one is inhabited by two. The pion drives toward the target nucleus. At a certain point the pion is no longer a pion; what was temporarily matter transmutes back to energy. The energy flares, expands, expends and fades. Other explosions detonate in the spaces within the patterns underlying larger patterns.*

*Darkness and light interchange.*

*The light coalesces into a ball; massive, hot, burning against the darkness. Pierced, somehow stricken, the ball begins to collapse in upon itself. Its internal temperature climbs to a critical level. At 600 million degrees, carbon nuclei fuse. Heavier elements form. When the fuel is exhausted, the ball collapses further; again the temperature is driven upward; again heavier elements form and are in turn consumed. The cycle repeats until the nuclear furnace manufactures iron. No further nuclear reaction can be triggered; the heart's fire is extinguished. Without the outward balance of fusion reaction, the ball initiates the ultimate collapse. Heat reaches 100 billion degrees. Every conceivable nuclear reaction is consummated.*

*The ball explodes in a final convulsive cataclysm. Its energy flares, fades, is eaten by entropy. The time it took is no more than the time it takes Sol-light to reach and illuminate the Earth.*



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"How do you feel?" Amanda leaned into my field of vision, eclipsing the fluorescent rings overhead.

"Feel?" I seemed to be talking through a mouthful of cotton candy.

"Feel."

"Compared to what?" I said.

She smiled. "You're doing fine."

"I had one foot on the accelerator," I said.

She looked puzzled, then started to laugh. "It'll wear off soon." She completed her transit and the lights shone back in my face.

"No hand on the brake," I mumbled. I began to giggle. Something pricked my arm.

I think Delaney wanted to keep me under observation in New Mexico until the anticipated ceremonies in Stockholm; I didn't have time for that. I suspected none of us did. Amanda began to worry about my moody silences; she ascribed them at first to my medication and then to the two weeks' tests Delaney and her colleagues were inflicting on me.

"To hell with this," I said. "We've got to get out of here." Amanda and I were alone in my room.

"What?"

"Give me a prognosis."

She smiled. "I think you may as well shoot for the Kalinga."

"Maybe." I quickly added, "I'm not a patient any more; I'm an experimental subject."

"So? What do we do about it?"

We exited NMMPF under cover of darkness and struggled a half kilometer through brush to the highway. There we hitched a ride into town.

"This is crazy," said Amanda, picking thistle out of her sweater.

"It avoids a strong argument," I said as we neared the lights of Los Alamos.

The last bus of the day had left. I wanted to wait until morning. Over my protests, we flew out on Ross Airlines. "Doctor's orders," said Amanda, teeth tightly together, as the Twin Otter bumped onto the runway.

I dream of pions. I dream of colored balloons filled with hydrogen, igniting and flaming up in the night. I dream of Lisa's newsprint face. Her smile is both proud and sorrowful.

Amanda had her backlog of patients and enough to worry about, so I took my nightmares to Jackie Denton at the observatory. I told her of my hallucinations in the accelerator chamber. We stared at each other across the small office.

"I'm glad you're better, Nick, but—"

"That's not it," I said. "Remember how you hated my article about poetry glorifying the new technology? Too fanciful?" I launched into speculation, mixing with abandon pion beams, doctors, supernovas,



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irrational statistics, carcinogenic nodes, fire balloons and gods.

"Gods?" she said. "*Gods?* Are you going to put that in your next column?"

I nodded.

She looked as though she were inspecting a newly found-out psychopath. "No one needs that in the press now, Nick. The whole planet's upset already. The possibility of nova radiation damaging the ozone layer, the potential for genetic damage, all that's got people spooked."

"It's only speculation."

She said, "You don't yell 'fire' in a crowded theater."

"Or in a crowded world?"

Her voice was unamused. "Not now."

"And if I'm right?" I felt weary. "What about it?"

"A supernova? No way. Sol simply doesn't have the mass."

"But a nova?" I said.

"Possibly," she said tightly. "But it shouldn't happen for a few billion years. Stellar evolution—"

"—is theory," I said. "*Shouldn't* isn't *won't.* Tonight look again at that awesome sky."

Denton said nothing.

"Could you accept a solar flare? A big one?"

I read the revulsion in her face and knew I should stop talking; but I didn't. "Do you believe in God? Any god?" She shook her head. I had to get it all out. "How about concentric universes, one within the next like Chinese carved ivory spheres?" Her face went white. "Pick a card," I said, "any card. A wild card."

"God damn you, shut up." On the edge of the desk, her knuckles were as white as her lips.

"Charming," I said, ignoring the incantatory power of words, forgetting what belief could cost. I do not think she deliberately drove her Lotus off the Peak road. I don't want to believe that. Surely she was coming to join me.

*Maybe*, she'd said.

Nightmares should be kept home. So here I stand on my sundeck at high noon for the Earth. No need to worry about destruction of the ozone layer and the consequent skin cancer. There will be no problem with mutational effects and genetic damage. I need not worry about deadlines or contractual commitments. I regret that no one will ever read my book about pion therapy.

All that—maybe.

*The sun shines bright*—The tune plays dirgelike in my head.

Perhaps I am wrong. The flare may subside. Maybe I am not dying. No matter.

I wish Amanda were with me now, or that I were at Jackie Denton's bedside, or even that I had time to walk to Lisa's grave among the pines. Now there is no time.

At least I've lived as long as I have now by choice.

*That's the secret, Nick . . .*

The glare illuminates the universe. ■



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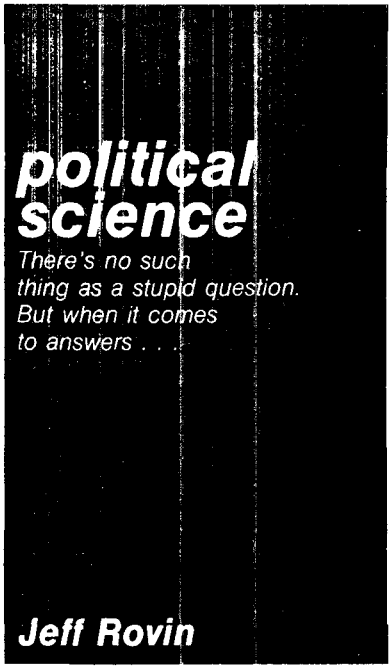


For the sake of simile, let's assume that humankind's first scientist was the Paleolithic man who struck marcasite to flint, accidentally set himself ablaze, and realized, in his last moments on Earth, that he had learned how to make fire. He was also, in this capacity, one of our first teachers: those who had witnessed his tragic demise knew that, henceforth, they must treat the strange fire-stones with greater respect.

In a way, we fans of technology are not unlike those prehistoric peoples. We've seen what science can do, from making a fire to landing a transistorized laboratory on Mars. However, we want to see science do *more*, and the problem is that things are more complex than they were a half-million years ago.

That humankind's future is inalterably linked to technological progress is no revelation to readers of Analog. Unfortunately, this truth has been slow to dawn on our political leaders. *Too* slow, in fact. For this reason, almost a year ago, I decided to learn where the man who was then the nation's most powerful governmental official, Gerald Ford, stood on a broad range of pertinent scientific issues. I wrote to Mr. Ford's Press Secretary, Ron Nessen, stating my goal; Mr. Nessen replied, within days, that, "The President would like to help, if possible, with your request for information concerning the role of technology in our future for Analog Magazine. If you will submit your questions in writing, the President will be happy to answer them in writing." I did as Mr. Nessen suggested; my questions were as follows:

1. Is it politically viable for the United States and the Soviet Union to spearhead an international manned expedition to Mars? If so, when?
2. Researchers involved in molecular and genetic study have expressed concern over the fact that artificial mutations could escape from laboratories and contaminate the world. What should the safeguards be in such research?
3. NASA studies show that the United States can build a hydrogen-fueled, economically attractive, Mach-3 supersonic transport that would produce minimal air pollution. Should



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the government support the development of such a program, particularly in light of the high rate of unemployment in the aerospace industry?

4. KMS Industries was able to produce a laser-fusion reaction after only four years of research. Government supported laboratories were unable to accomplish this feat in twenty-five years of experimentation! Why is there such a discrepancy between the effectiveness of public and private facilities?
5. Eventually, man's coal and fuel supplies will be exhausted, and we will have to turn to the Sun and the atom for energy. Should we move ahead on nuclear and solar power sources, and if so under what sort of program?
6. Should mass or private transportation be advanced as the preferred mode of travel for the future?
7. Should the United States launch a massive effort to draw sustenance and living space from the ocean?

Six months later, Mr. Nessen sent me the following response, as insightful as any in an election year: "Although I had indicated to you that the President would be pleased to try to answer your questions, that has just not proved possible. Please be assured that the President does share your concern, and the concern of your readers, for the advancement of science and technology. As you know, he did call for the establishment of an Office of Science and Technology Policy to make sure that these two fields receive proper recognition, and recently nominated a distinguished scientist to be his new White House Science Advisor."

If this were simply a matter of hedging an issue, we would be disturbed, but not unduly so. However, we are genuinely concerned that the men and women running our country *have* no vision of the future, be it vital with technology or otherwise! For this reason, we intend to renew our digging, learn where the new Administration stands on science, and present our findings in an upcoming issue. In the meantime, the subjects we raised *are* important and *should* be pursued, not only through the Executive Branch but through the Congress as well. Yes, we need programs that will give goals to the rootless and an education to the underprivileged; yes, we need improved transportation facilities and safer city streets. But we also need science, for these and, indeed, every problem we will ever face are in some way related to technology. Thus, we urge that you write to your own representatives and ask for *their* views on these crucial scientific matters. And, if you've got a moment, drop us a line and share your findings. Who knows? It may be time for a new and damned *determined* lobby! ■



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# nuclear RUN

JOHN SCHOENHERR

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*Newton's Third Law works for people, and societies, too.* **William E. Cochrane**

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*"Rosarita Sam is coming out, Señor."* The phone connection was the usual patchy-scratchy contact of a Baja Telephono Publico. Hotels and private lines, where the Policia thought they would hear something, had good clear service because the Policia didn't want to strain their ears. Public booths could go to hell, and did. But, patchy-scratchy or not, the miracle of the *telephono* service provided uninterrupted long-distance dialing to anyone who had the proper number to dial.

And so, minutes after the black-striped boat of Rosarita Sam had bubbled its way out into the bay, a fish cleaner who slept under the dock had used some of the coins he had been given. The coins went into the *telephono* and he dialed the number in Los Angeles. When the voice answered, he gave his message, answered a few simple questions about whether the boat was loaded and if he knew its course.

"Si. I have seen them bring things on board just before midnight." And if he knew their course . . . "No, señor. Just north, the way you said."

Joe Draco said, "Gracias," to his unknown informant and hung up. He sat up and switched on the lamp. Nothing! *Oh, yeah. An extra electric ration night. He'd heard the announcement on TV this morning. The South Coast Power Link was off-line from 11:00 P.M. to 7:00 A.M. That was San Onofre Power Plant again. Their management was lousy. What was it now? Three ration nights in the week, and the Sunday daytime cutoff that had been national policy for a year.*

*San Onofre . . . well, that was probably what Rosarita Sam was coming north for. San Onofre couldn't run forever on its legal allotment of uranium fuel pellets. Not with all of Los Angeles-Orange County draining its output.*

He sat up on the edge of the bed and tousled his hair. *Should he wait and see if anybody else called? The fuel boy at Luis's might call. And there were fishermen who might be mad at the noise of Sam's motors . . . no, Sam was spreading money around down there, too. They tended to treat him like a local bandit chief. This one call was the only solid lead that had come out of seven months of work. The only one he was likely to get. Rosarita Sam was bringing black market fuel north tonight. It had to be. San Onofre was almost shut down.*

Draco picked up the phone, dialed and said, "Draco here. Sam's coming out. I need your boat. Yes, I know what time it is. How soon can you be ready? That's right. Max fuel load and set for a fast chase. There'll be a Coast Guard boat out to refuel you . . . No. You know our standard charter paper. We'll make it gas extra, Humph . . . three o'clock would be better . . . at the fuel dock, then—bring enough gear for Michealston."

He hung up . . . and dialed again.



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"Dr. Michealston? We're going out this morning. I need you along . . . To make some long distance checks for radioactive material, and a legal identification, later . . . Very well . . . The fuel dock at Humph's Marina. Know where it is, don't you? . . . Good. Bring your black boxes, but watch the weight. We don't want to pound the bottom out of Humph's boat . . . Right! Be there by three A.M."

His next call was to the Coast Guard base in the harbor. He asked for the duty officer and gave his identity, a series of three code words and a time. The duty Ensign said, "Just a moment, sir," checked the codes and concluded, "Message logged, sir. Radio frequency 123.1 Hertz."

Draco repeated the frequency while listening to the background noises of the Coast Guard's CQ klaxon. The Ensign was fast off the mark at least, but the frequency wouldn't do any good. Humph's boat didn't have a radio.

Draco hung up and began dressing. He stuffed his electric razor in his jacket, put two sweaters, his ski gloves, and a knit cap in a flight bag, added an unopened bottle of bourbon and an empty thermos, then zipped it shut.

Another bag, about the size and shape of a golf bag, but with special pockets and about twice as heavy, came out of a closet. Draco added a waterproofed folder from the desk to his kit bag and he was ready to go. The folder contained his warrants and authority to stop and search Sam's boat on the high seas plus the permits that made it legal for him to carry what was in the golf bag.

At two-thirty in the morning the basement garage was deserted and hollow under the battery-powered emergency lights. The streets were black and deserted pools between the low-energy safety lights. Usually there was some traffic around the airport, but tonight Draco had the roads all to himself.

The marina fuel dock, with explosive-proof carbide lamps, was a bright pool of light in the morning darkness. Michealston had arrived before Draco and was sitting on his black boxes. Humph wouldn't let anybody near his boat while he was fueling it.

The fueling dock ran a restaurant on the side and Draco functioned himself two scrambled egg sandwiches, ordered a pair each for Michealston and Humph plus some coffee that tasted like gasoline and probably couldn't be made any hotter on that stove even if it were clean. He topped the thermos off with part of the bottle of bourbon to kill the taste.

Draco paid for the sack of food and bullied a receipt out of the cook. Commerce Department accountants were used to the grease stains on his expense accounts, but they insisted on a piece of paper for every meal charge. Draco exercised his bureaucratic sadism by sending in things



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like fried egg sandwiches for three from a fuel dock, and tacos and clams for twelve—that had been a flower farm in Mazatlan.

San Onofre's power shortage had cut off the fuel pumps, forcing Humph to work a very inefficient hand-pump. The owner wasn't interested in labor, just profit but with a lot of swearing and two skinned knuckles Humph got his fuel load and waved Draco over. When Michealston started lugging his cases toward the boat, Humph started complaining that he didn't have any cargo space on board: "Shea-ah, Draco, what do you think I'm running, a cargo-class launch? Of course you do. Have cargo space, will haul, that's me."

Humph and Draco had run with each other before and Humph's *Em Owl* had a reenforced tie-down pad, up under the dash. It also had some other strengthened points that Draco had ordered Humph to install—with the bills going to the Commerce Department.

Humph grumbled, but loaded the gear himself, and lashed it down. He didn't want it tearing loose when the boat started to run.

Draco helped Michealston into a flotation jacket and shock harness. The shock harness was designed to hold him in the cockpit when Humph's *Em Owl* was running at speed, and included a back-pad to protect his spine when it slammed back into the seat. Draco struggled into the same kind of a rig. *Em Owl* was a deep-vee bottomed ocean racer—fast, strong, and as rough-riding as driving a car off a cliff. The flotation jackets were to protect them in case the boat broke up—or to let their bodies float long enough to be picked up. Crash survival at Humph's max racing speed had a low order of probability.

"Okay, I'm ready for you two now," Humph said. "Draco, you take the starboard seat. The brackets and belt loops you asked for last time are over there."

Draco nodded and stepped carefully aboard. Humph's *Em Owl* rode so evenly balanced in the water that entering it, or moving around when it was docked, made the hull rock. Draco felt off balance, insecure, until he was seated and strapped in.

The boat rocked to Michealston's weight, then dipped and bobbed as Humph dropped in behind the midship's driving wheel.

"Show him how the safety harness buckles, Draco," Humph said. "I'll go out on the little banger, but I want to test the big twins as soon as we clear the harbor mouth." He started the small outboard and pulled away from the fuel dock. The little motor was noisy in the still morning, but nothing compared to the screaming roar that Humph could call out of the two 140 h.p. racing outboards built into the boat's transom. Those two monsters would wake every living thing within a mile of the marina—probably break a few windows.



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The marina was usually a toy city of colored lights reflecting in the mirror-still water. Tonight the houses and dock lights were out, the buildings and boat hulls were black shadows in the morning dark. The harbor was dead, heavy and oppressive in its power-rationed silence. *Em Owl* maneuvered down the channel, following the lighted buoys. Draco felt as he had on the roads into the marina; they had the harbor channel all to themselves.

The Coast Guard base, powered by its own generators, was a blinding strip of lighted dock, but the cutter, *Cape Victory*, was still singled-up to the piers. She took some time to get her reactor steam-pressure up, but she would make the rendezvous on time. Draco had long before planned out a timetable with her Captain and Navigator.

Eventually, Humph pointed to the flashing buoy that marked the harbor mouth and shouted, "Helmet time! I want to run fast for a bit."

Draco put on the crash helmet and buckled it tight. He saw that Michealston had figured out how to wear the helmet and was pointing to his ears happily. Yes, the main reason for the helmet was the sound-deadening ear protection. Draco made tightening signs toward Michealston's safety harness. Humph looked back briefly to see if his passengers were buckled in properly, then started the two big racing outboards and faced forward. He forgot Draco and Michealston in an instant; his sole concentration centered on driving the boat.

*Em Owl* came alive. Her motors screamed into a roar that Draco could hear with his bones. The bow slammed into the first wave with a thud, bounced up until it blotted out the horizon ahead, and stayed at that impossible angle when Humph caught it with a burst of the throttles. The surface of the sea began slamming at the bottom of the boat, beating at Draco's feet and jarring the muscles in his legs. The boat rose with the sea swells and dug the safety harness into Draco's shoulders and legs.

Michealston slapped Draco's shoulder and pointed aft, eyes wide with wonder. The boat was spraying a ten-foot high rooster tail, a swirling white spray-jet blasted up and back by the driving double-propellers.

Draco grinned, tasting the salt spray as it was driven into his open mouth, and nodded his head. Michealston had never been out in Humph's boat. He'd never ridden in anything faster than a Coast Guard launch. Sitting under that blasting vapor spout was like running ahead of a screaming tornado.

The rooster tail died, fell out of the air behind them in a gray-white ghost of drifting spume, as Humph cut the throttles and went back to the one-lunged banging of his trolling motor.

"Well, they'll work when we want them," Humph yelled.

"Say again?" Draco pulled off his



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helmet to clear his hearing.

"I said, they work. Which way you wanna go?" Humph said. "And what are we after this time?"

"South. Along the coast. Down below San Onofre, and stay well out to sea so they can't see us from the power plant. There is a shipment of nuclear fuel pellets coming out of Mexico and the San Onofre Power Plant is the buyer. They've been dealing on the illegal market for sometime, here, and in Canada. Two months ago they got careless, or rushed, and we were able to trace the deal. Rosarita Sam is bringing the fuel pellets up tonight—today—direct delivery to San Onofre. Somebody'll come out through the surf to get the fuel, I guess. My job is to catch Sam at it while he's making his run—get the fuel pellets before they can be transferred to San Onofre, if possible, but get Sam.

"Dr. Michealston's riding along—with his gear—to check the radiation of the shipment for evidence. And he may help us locate Sam's boat if it's emitting anything he can trace. He's my expert."

"Okay. Glad to have you, Doc." Humph said. He nursed the trolling motor into making its cruising noises and locked the throttle. "Well, it'll be a longish trip at this speed. Settle back and get comfortable. Did I see you bring a coffee thermos in with all that junk?"

The coffee was poured and the boat droned on. After two hours, Humph decided that the day was light enough for them to be seen, so he rigged two fishing poles with sinkers and a spinner lure, but no hooks.

"We gotta look like we're fishing, but I don't want no fish in my cockpit," Humph explained. "I don't want to get my boat all bloody."

"Take a pole, Michealston," Draco said. "You and I have to look like we are fishing. Humph stays clear of all forms of work, even phoney work."

"I gotta drive the boat, don't I? You can't even steer a straight line."

"You two make a good team," Michealston said, streaming his weight and spinner aft. "How long have you been doing this?"

"With Rosarita Sam? What is it, Humph? We've chased him six times now; last time was in this boat and we almost caught him. Before that it was the Israeli nut with the midget submarine. But the California kelp caught him, we just rescued him . . . and Humph had to dive for the fuel canisters."

"Seems like I've been at it longer. My granddaddy used to tell me war stories about chasing rum-runners off the Carolina coast. He had a big wooden hull with a 450 horsepower Liberty engine in it. A V-12 inboard. Gawd, that was a World War I airplane engine—big as this whole boat, to hear him tell it—and faster'n a scalded cat. Brute power.

"Well, Grandpop and the Treasury boys used to lurk around off the coast until the boats came across



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from Bimini, then chase 'em in before they could disappear into the swamps. A big game. Half the time the runners had better boats than the Treasury. I always suspected that the ol' man changed sides more'n once."

"Don't you get any ideas," Draco said. "One Rosarita Sam is all I need."

"Not to worry. Drinking whiskey is one thing, but I can't use refined uranium for anything. Whiskey's legal and nobody has to smuggle it. Uranium's not legal and San Onofre's got to get it where they can, to keep on making power. Me, I ain't in the power plant business."

"I think I've got a shark following my spinner," Michealston said, a tone of panic in his voice. "What do I do if he strikes?"

"How you gonna stop him," Humph said. "Draco, reel in your line as fast as you can. Mike, you do the same, but slow. Don't worry if he hits the spinner. The line'll break. When you get the fish-line out of the way, I'll run the twins and scare him off."

"I'm in." Draco pulled his spinner out of the water.

"Hey!" Michealston said. "He took the spinner, I think. Yeah, look." He reeled in an empty line.

"Okay. Here go the motors. Hold yer ears." Humph hit the starters. The big twins coughed into life and the water swirled a white wake behind the transom. The boat lurched forward, then settled down as Humph pulled the throttles back.

"That'll do him in," he said, cutting the switches on the big, twin outboards. "Those props make a hell of a racket under the water."

"Do you suppose he ate that sinker and spinner?" Michealston asked. He was still staring at the wake, where the shark's fin had veered away and disappeared.

"Likely," Humph said, pointing the boat back on its course. "I seen one chew hunks out of a life raft, once. They eat damn near anything."

"Hate to think of all that metal in its stomach," Michealston said.

"Don't complain to me," Draco said. "I'm Commerce Department, not Fish and Game." He leaned his pole outboard again to keep up the fishing illusion, but he didn't put the line back out.

"You know—now that you brought it up—I've been wondering . . ." Michealston said. "Why *are* you out here chasing down what amounts to a case of border smuggling. I mean why not the Treasury Department, or the FBI?"

"Actually it boils down to *what* Rosarita Sam is smuggling," Draco said. "If he was running rum or green-card labor for the cotton fields, I probably wouldn't be out here. But nuclear fuel . . . It's a technical backlash, actually. The Commerce Department is empowered to license the export of nuclear power plants and technology. So, when our own national power plants were forced to



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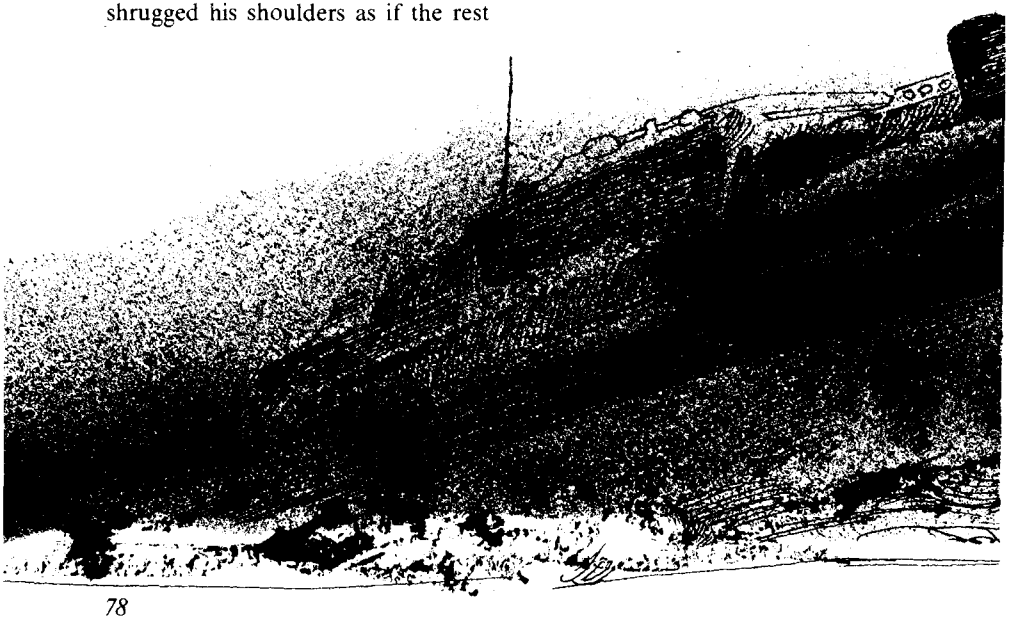
meet tighter and tighter environment and safety licenses—environmentalists and bad press during a couple of elections—and started cutting back . . .

"Well, about that time, the Commerce Department was doing more business in foreign licenses than it was in domestic ones—about fifty to one—so the Congress figured they ought to be able to handle the US job too. Then, when the Uranium Embargo Act went into effect, our own plants here couldn't operate on the fuel allotments that they were getting from the Alabama production plants or domestic breeder reactors. Export of fuel was still a big, profitable business, and the power plants began to buy what they needed from out-of-the-country markets, and get it across the border somehow. Cash on delivery." He shrugged his shoulders as if the rest was self-explanatory. "Well, Commerce issued the export licenses, so Commerce got the police job of stopping the traffic. And here I sit, fishing for shark and Rosarita Sam. Story of my life.

"Any of that coffee left?"

"Can't you just lock up the San Onofre Power Plant?" Michealston asked. "Or fine them?"

"No, to both. San Onofre has a small breeder reactor on line. And they run an experimental uranium-enrichment line for Cal Tech. Any fuel pellets they have on hand can easily be accounted for by creative paper work. We can't shut them down, because they supply a significant percentage of the Pacific Power Link. Even with the ration days, it's better than cutting them out alto-





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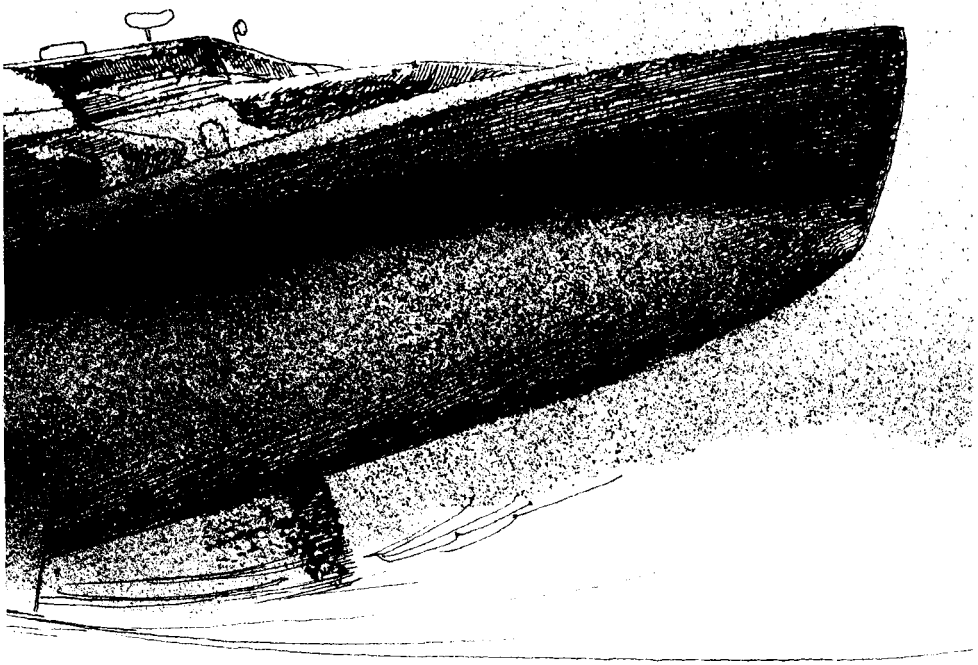
gether. Taking them out of the line would cause overloads on the San Diego reactors and the Apple Valley Complex. There would be complete blackouts and serious problems until the other plants could be reassigned larger fuel allotments. Law suits. Maybe we wouldn't even be allowed to increase the power output of the rest of the Power Link. The Safe Nuclear Operations Act is a strange body of law."

"Those other power plants would probably turn to smuggling," Michealston said.

"At least double what they do now. Apple Valley works through Canada. San Diego has a connection in Panama—from South Africa, we think.

"Anyway, San Onofre's more trouble than it's worth. Easier to stop, or try to stop the smuggling.

"Strange, really. Of all the worries the experts have had about the nuke plants—radioactivity, burn through, melt down, thermal runaway—nobody ever considered that they'd just run out of fuel. Sort of sad really. Just no fuel. The smuggling won't go on forever. I'll get Rosarita Sam this time. Somebody else'll close off the Panama pipeline. Then, they'll just run out . . . again."





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Draco watched the wake for a while silently. That was the last mention any of them made about the job for the rest of the morning. The trolling and sporadic conversation went on as Humph navigated the boat south with his wristwatch, a gimballed sailboat compass screwed into the dash-top, and a two-fold chart torn out of a magazine.

About noon, Humph pointed off toward the coast.

"San Onofre," he said. "See the white domes? 'bout all you can see from out here."

"Can they see us?" Draco asked. "That's important."

"We're maybe ten, fifteen miles out. They can see a boat . . . maybe. But we're in the middle of the Santa Catalina Channel. It's a highway for boats going to the Island and to Diego. Fishing, marlin boats—even saw a submarine in here once. Keep fishing, nobody'll notice."

An hour more of the rolling, sputtt-putt, trolling and Humph said, "Near as I can figure we're at your spot, Draco. You want to mark a wave?"

"Oceanside?"

"Uh huh. Off to port. What next?"

"Pull a wide circle to seaward. We'll stay in this area a while. Let Sam come in to meet us, now."

"Draco, you said this Rosarita Sam has a fast boat?" Michealston said. "How fast? When did he leave Mexico?" Michealston had been doing some speed estimates in his head.

"He left Puerto Vallarta some time before midnight," Draco said. "My man didn't say hours and minutes. Humph and I are betting a lot of time and money that his boat isn't quite as fast as *Em Owl*, here."

"He means, how long will it take Sam to make the trip, Draco," Humph said. "You didn't tell me, midnight. What the hell are we fuddling around out here for?" He growled the question at Draco as he realized what Michealston was asking.

"Sam's boat *can* make the run full-out, Doc," he went on more calmly. "He can carry fuel for an average speed of 65 to 70 mph. By the time he gets here, running empty, Sam can boost his boat up to 80 mph for a short time.

"He *can* . . . and if somebody was chasing him, Sam might make the run at that high speed. But I think he'll come up at a steady cruise. That'll still be fast—35 to 40 mph—but he'll have some getaway fuel at the end."

"I'm betting that he makes a speed run," Draco said. "I want him coming in tired and brutalized by the boat, to the point where he'll make mistakes . . . and in a high-speed boat, he won't have to make too many. I'll get him."

"*I'll* get him," Humph said. "*I* got to drive *this* boat to chase yer boy. And you want me to sit out here in this channel chop all day?"

"No. No way, Humph," Draco grinned. "You ought to get some



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sleep. That's what I'm worried about. I didn't plan to stay out here all day. Where is that Coast Guard boat, anyway?"

"Behind you," Humph said calmly. He'd steered *Em Owl* into a 180-degree turn and Michealston was on the seaward side of the boat.

The cutter was riding high on its hydrofoils, a line of sky showing under her sea hull as she came straight in toward the circling racer.

"I never can get used to seeing a ninety-foot boat flying up out of the water," Humph said.

"She'll settle down pretty soon," Draco said. "They must see us by now. Yup, she's slowing. Head outside of her, Humph. The Captain's supposed to have a boarding ladder out on his starboard side for us—away from the beach."

"Not till I see what he's going to do," Humph said. "He's still making too many knots to risk crossing his bow."

The cutter slowed, lowered her hull into the water and continued to run in toward the waiting racer. The white curl of her bow-wave shrank from a full arc to a gentle, breaking vee, then finally, when the cutter had closed to about ten yards, a roiling ripple.

"That's good enough," Humph said. "He's barely holding steerageway. I'll pick up the rest." He spun the steering wheel and headed down the left side of the cutter—its high, white, red-striped starboard side.

There was indeed a landing stage rigged, and two sailors were setting a boom out over the water, hanging it from a deck crane and fastening it to the boarding platform. Humph's practiced eye saw enough fenders on the platform to protect his hull, judged the wave action and nosed *Em Owl* alongside the ladder.

A petty officer, standing by, hooked a line into *Em Owl*'s bow-eye with a swift, easy movement and figure-eighted it around the running line on the boom.

"Ah, I was right. Three men in an open boat." The Coast Guard Captain was leaning over the aft bridge-rail. "Well, we will render all possible assistance. Bos'n, those survivors appear to be suffering from exposure. I think our MO ought to have a look at them. Don't you?"

"They certainly are exposed, sir." The bos'n was kneeling to hold Humph's boat against the fenders of the landing stage. He reached in beside Draco, unclamped the coffee thermos and shook it. "And they seem to be out of—er—dehydrated, sir."

"Undoubtedly," the Captain said. "Get the survivors to the wardroom, if you please, Bos'n. I think the Doc can come up with a medicinal rum ration."

"Survivors?" Michealston asked. "Of what?"

"Of Humph's boat driving," Draco said. "Let's get aboard. We'll be here for a longish while—till sundown, probably."

"Survivors of the Coast Guard's



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rum ration, more likely," Humph said. "I've heard about Captain Henderson around the marina. His last ship was on iceberg patrol up around Sitka, before they gave him this flying fish. He may keep a dry ship by regulations, but his idea of how to treat survivors might run to iceberg standards. Hot rum and thick steaks. Let's go!"

Humph was eager, but he stayed on the landing stage long enough to watch the sailors rig his racer outboard on the boom, so that she rode clear of the stage. The cutter wasn't going to anchor and the boom would keep the small boat alongside while the big one held station with her engines. The Coast Guardsmen did a seamanlike job and Humph was satisfied that his paint and hull wouldn't be damaged, so he followed Draco up the ladder and let himself be guided forward to the wardroom.

There the Captain, Draco, and *Cape Victory*'s navigator were already bent over a chart that the navigator had taped to a big piece of drawing board at the end of the table. Another officer was standing by the coffee urn with Michealston and waved Humph over.

"Welcome aboard. I'm Bill Dickers, MO," he said. "Get your coffee, and I'll administer first aid." He pulled a small medical bottle out of his pocket and uncapped it. "One enough? More if you like. This all goes in the log under your code security and nobody's counting." He emptied the bottle into Humph's cup.

"Maybe later," Humph said. "I'm driving." He knew what Draco wanted him to do with *Em Owl* when Rosarita Sam showed up. He didn't want to get his reflexes dulled. The rum coffee was good though. The morning had been cold.

"Would you like anything to eat? The galley shuts down when we run on the wings, but I can scare up some sandwiches. The cooks'll be starting lunch."

"Yeah. That'll go good," Humph said. "And thanks—for this."

"Por nada. I'll see the cooks." And he left.

"Humph! Michealston! Come take a look!" Draco called, then introduced. "Captain Henderson—Dr. Michealston, Humph Arnold, my team."

"Gentlemen. Glad to have you aboard. This is Lt. Andrew, my Navigator."

"Pleased . . ."

"Captain. Lt. Andrews." Humph didn't try to shake hands. He had the table between him and the officers and the coffee. Beside he rated Captain's honors too. *Em Owl* was faster than this flying fish. And, if his guess was right about Draco's golf bag, the *Owl* had her out-gunned.

"That our job you got all charted out?" he asked.

"Right, Humph. This is the way it looks," Draco said, tracking a path on the chart. "If Captain Henderson holds station right here, his radars



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should be able to track Rosarita Sam out to about here. Since he's running for San Onofre, my guess is he'll stay in close and come up the channel . . . so. As soon as radar sights him, we go out like this . . . and stop him.

"I expect him to break and run—figuring that he can get away from us like he always has—this way . . . to deliver his cargo. He only needs a short lead to unload and get out again. He'll think I'll stop and chase whoever comes out for the cargo. But that's a mistake I want him to make. This time, I'm going to get Sam! To hell with his cargo!

"See. If we get him running this way, he'll be heading right back at *Cape Victory*, here. She can block him."

"She won't be able to catch him," Humph said.

"Not if I start from a standing stop," the Captain said. "But if you can keep him occupied I can get the *Victory* up on her hydrofoils and running at flank speed."

"Horse pucky!" Humph said. "With all due respect to your ship, Captain. If Sam's boat is as hot as we've heard it is, you won't stand a chance of getting near him. He's run away from me once.

"But go ahead and try. You may rattle him enough to make him goof. You've got a big boat. It scares the hell outta me.

"As for us, Draco . . . I want to curve in like this . . ."

"Nope. Straight out. I want to get to him fast as possible."

"The quicker we have two radar targets to identify, the quicker we can get the *Victory* up to speed, Mr. Arnold." Lt. Andrews put in.

"Works great on a chart," Humph said. "But you got no idea how much sea I need to turn around and chase him." He ran his finger down the imaginary course Draco had pointed out. "You want me to go out there, stop, turn and chase him back. Shea-ah! We might as well throw out an anchor here and go fishing. Draco, he'll go by me at 80 mph at that point, you realize? I got to be moving at least that fast, and somewhere close to the right direction.

"Then suppose he breaks out to sea. I'll skid all over the bay making a U-turn. On that course you'll have me in the surf line if I have to turn to port.

"Nope." He reached for a sheet of clear acetate from the navigator's kit. "Give me time to go out and loop back in." He was drawing the course on the gel. "I want to be headed ninety degrees to his course . . . so. Then I can shag him either way he turns, and we'll both be turning at the same rate. Both of us will lose the same amount of speed on the turn, whatever it is."

"And if he goes straight by you?" Draco spotted the weakness in the plan.

"Hell, that's what you want him to do, isn't it? Head back here toward the cutter? And he's being paid to deliver his cargo. Sure, that's what



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he's going to do. I figured I was going to be chasing him. You expect him to stop, just 'cause you asked him?"

"No." Draco was silent a minute. "We'll do it your way, of course. That's what I brought you along for, Humph. Give the Captain a rough idea of where you'd like to make the intercept and Lt. Andrews will plot out a good course for us, when Sam shows up on the radar."

Humph finished his freehand course on the chart overlay and said, "That ought to do. If he's running fast we'll be able to see him within a mile. Do the rest by eye."

Lt. Andrews nodded, taped the gel to the board. "Good enough," he said. "I'll give you a good bearing."

"Very well," the Captain said. "As for the rest, you gentlemen can make yourselves at home here in the wardroom. The crew will be coming in for lunch shortly, but you are welcome to join them. I have to get back to the bridge. We are holding station in what can be a crowded channel at times."

"One more thing, Captain," Draco said. "Can I borrow an electronic tech for a little while? Dr. Michealston needs to modify some of his equipment."

"Radio or radar?"

"Radar would be best," Michealston said. "It's mostly an antenna problem."

"I'll send somebody," the Captain said. "And I see you've already made arrangements to join the crew for lunch." He had a grin on his face and was nodding toward the medical officers balancing a tray of sandwiches in through the hatch from the galley.

"Make yourselves at home," the Captain said again and went out, back to his bridge. Lt. Andrews folded up his chart board and followed.

A seaman, a radar specialist, showed up and went off with Michealston to "*Look at the job.*" Humph slouched in a corner of the wardroom couch and was asleep in seconds, hoarding his energy against the fantastic demands that would be made on him when he drove *Em Owl* full-out later on.

Draco, unable to sleep, and unwilling to wait out this part of his search in a quiet wardroom, asked the way to Radar Plot and went forward to wait for Rosarita Sam in a place where he could see what was going on.

*Cape Victory*'s Radar Plot was a large compartment connected to, and one and a half decks below, the navigating bridge. Because of *Cape Victory*'s speed on hydrofoils and her coastal assignments, the radar and sonar gear was a little better, more modern, than most. Because of Captain Henderson's ice patrol experience, the training and manning of this gear was a lot better than most CG cutters.

Draco tucked himself into a bulkhead corner, out of the way, and watched the Ensign and his three



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ratings run the *Victory* from their dials and scope sweeps. They acted like they were an aircraft carrier combat information center. Certainly, in this close to the coast, they were eyes and ears for Captain Henderson—they could see more than he could—and he conned his ship from their directions in full confidence.

The compartment was filled with unfamiliar equipment, but Draco found the main radar screen and was amazed by the number of blips it revealed. This was a crowded channel. Michealston and his black box might be the only way of spotting Rosarita Sam if the Ensign and his crew couldn't identify his particular blip.

Draco watched them work, interested and completely absorbed in the show. A watch change brought him sandwiches and coffee.

About 5:00 P.M. the duty Ensign passed him a note. *Michealston says, All finished.* Shortly after that, one of the radar operators said, "Hey, what've we got.

"Bearing Mark 140. Long streak. Mister Toma, take a look."

"I see it. Switch this one into PDI. We'll track it. Sonar? Anything on long range?"

"Nothing, sir. Too far out."

"Bearing 137. Mark. Speed 44 knots," the operator read from his dials. "Hey. Something wrong with this scope? Is that possible, huh?"

The Ensign looked back at Draco, his eyes asking the question. Draco nodded.

"The man says yes," the Ensign said. "That's our target.

"Radar to Bridge. Have target on my scopes. Bearing 134. Range ten miles and closing. Data is on PDI."

A klaxon horn went off somewhere outside the compartment and a speaker over the Ensign's head announced, "Action Stations! Stand by to get under way. Wing Speed. All personnel below decks for hydrofoil run. Small boys to the side. Small boys to the side."

"That's you, sir," the Ensign said to Draco. He'd gotten some orders on his headset. "*Small boys*, is your boat. They want you at your boat. Navigation will have your course for you. We're feeding bearings up to the PDI automatically now. Good luck."

"Thanks," Draco said. "And trust your instruments, Ensigns. That's a fast boat out there. So is mine. Watch your closing speeds when *Victory* starts moving. She's pretty speedy too, I've heard."

"That's affirmative," the officer said, grinning. "We'll watch out. You heard the man, Kelly. Bend an eyeball."

"Aye aye, sir."

Draco left.

At the landing stage, Michealston was already in *Em Owl*, strapped in and with his flotation jacket and harness buckled up. Humph was there too, swearing and hollering about the modifying antenna horns and cables that Michealston had clamped and cemented to *Em Owl*'s



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forward deck, just ahead of the windscreen.

Humph threw Draco's flotation jacket at him and continued grumbling as he stepped into the boat and leaned over the windshield to make a close inspection of the cable and antenna installation.

"I had them glue everything down," Michealston said. "There aren't any holes in the hull. You can take solvent to the glue joints and remove them whenever you want."

A seaman handed Draco the intercept course—a section of a chart, clamped under the clear grid of a maneuvering board. The thin line of the course had bearings and times marked on it in half-inch high letters. The Navigator had his head on straight; he'd figured out how hard it would be to read anything in Humph's boat, at speed.

"Here's your course," Draco said. "Let's move out, fast. I don't want to miss Sam." He got on board, strapped in and began to unpack his golf-bag case.

"Shea-ah!" Humph screamed. "Rocket launcher? What are you going to do to my paint? Draco, why?"

"How the hell do you expect to stop him?" Draco said, clamping the launch tube to the clips. "Wave at him? Don't worry. The rockets clear out of here so fast they won't even heat your paint. Go, man!"

Humph started the trolling motor, the bos'n cast off the bowline and guided *Em Owl*'s bow clear of the landing stage as Humph backed away from the Coast Guard cutter.

"Put your helmets on," Humph said. "I'll go over to the big motors."

"Hold on a bit," Michealston said. "I talked the radar tech out of three sound-powered headsets. We can talk when the motors are on."

"Ain't science wonderful," Draco said. The tiny earphones and microphone fit comfortably under his helmet.

"Gonna be too busy to talk," Humph said shortly, but he jammed the headset over his ears before he ducked his head into the helmet. His "Everybody set?" came clearly out of the earphones.

The big twin motors started up with a double cough and Humph slid *Em Owl* around in a tight turn to pick up the first compass heading. Draco caught a spinning glimpse of *Cape Victory* as they turned. The boom and boarding stage were gone from her hull-side and she was already making a white-water wake, picking up speed to ride on her hydrofoils. Then Humph opened his throttles and Draco was slammed against the seat back as *Em Owl* jumped into the air off the top of the first swell and came down screaming in her max-speed run. The rooster tail spouted its white explosion into the sky behind them.

Humph started swearing. He chanted a single-word-at-a-time litany that was matched to the jarring, jolting rhythm of *Em Owl*'s running



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across the water. The swearing was an emotional exercise that let him time the split-second juggling of rudder and throttle he was using to drive the boat at its racing speed. He sang an ever-changing pattern as *Em Owl* met, hit, rode over the shore swells; slammed back onto her running vee; planed nearly her whole length out of the sea; then repeated her bucking bag of tricks in a new combination. A second's inattention—the straining twin propellers could last only moments out of the water before whirling themselves to destruction—and the sea would tear *Em Owl* apart. Humph cursed and fought his boat across the sea.

Draco was shaken and pounded by the ride. Unused to the rhythm of the boat's high-speed leaps, he was forever off balance. Braced in the wrong direction, he found himself jarred against his straps again and again, and slammed cruelly down into the seat. But he made no attempt to stop Humph's driving, full-throttle pace. Speed was what he'd wanted from Humph's *Em Owl* and speed was what he was getting. The boat was moving fast and it was moving in the right direction—toward the smuggler boat of Rosarita Sam.

In addition to the punishment he was taking from the hull and the safety straps, Draco was in pain from the weapon he'd mounted on the side of the cockpit. The rocket launcher was pounding a bruise in his shoulder every time the boat rolled its starboard rail up out of the sea with a short, savage jerk. Draco was beginning to doubt his ability to fire the rockets if he ever got a target to shoot at.

Humph yelled, "Turning!" and left Draco's ears ringing from the rattle of the overloaded headset, while the motors changed pitch and the g-forces of the turn jammed him against the launcher tube.

The motors quieted slightly, the white arc of the rooster tail lowered. The rhythm of the boat changed.

"Following sea," Humph said. "Can't push her so fast. She'll dig 'er nose in."

Draco felt the dip and sway of the stern as it responded to Humph's control. This was an easier motion to ride with, respond to, without being shaken up. He also felt the shake and quiver of his leg muscles as, released from the tension of the pounding they'd been subjected to, they spasmed out of control.

"There he is!" Michealston called. "Look! That's him isn't it?" He was pointing over Humph's shoulder toward the coast, now far away and shrouded by yellow-brown smog.

*Em Owl* was in a wave trough. Humph caught her with a short burst of throttle and, at the crest of the swell, the other boat could be seen—a swelling comet of spray, broken into a dotted-line white wake as the smuggler's boat moved to cross their path. The white wake was fresh and visible against the background haze.

"He's moving fast," Humph said. He juggled his throttle to get a little



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more speed, took a swell of green water over the bow, and pulled the throttle back. He was going as fast as the sea would let him.

"Late!" Humph said. "He'll go 'cross in front of us. Watch him, Draco. You can see his spray. I have to keep an eye on the sea. Watch him. He may turn toward us if he breaks for the sea. Yell out."

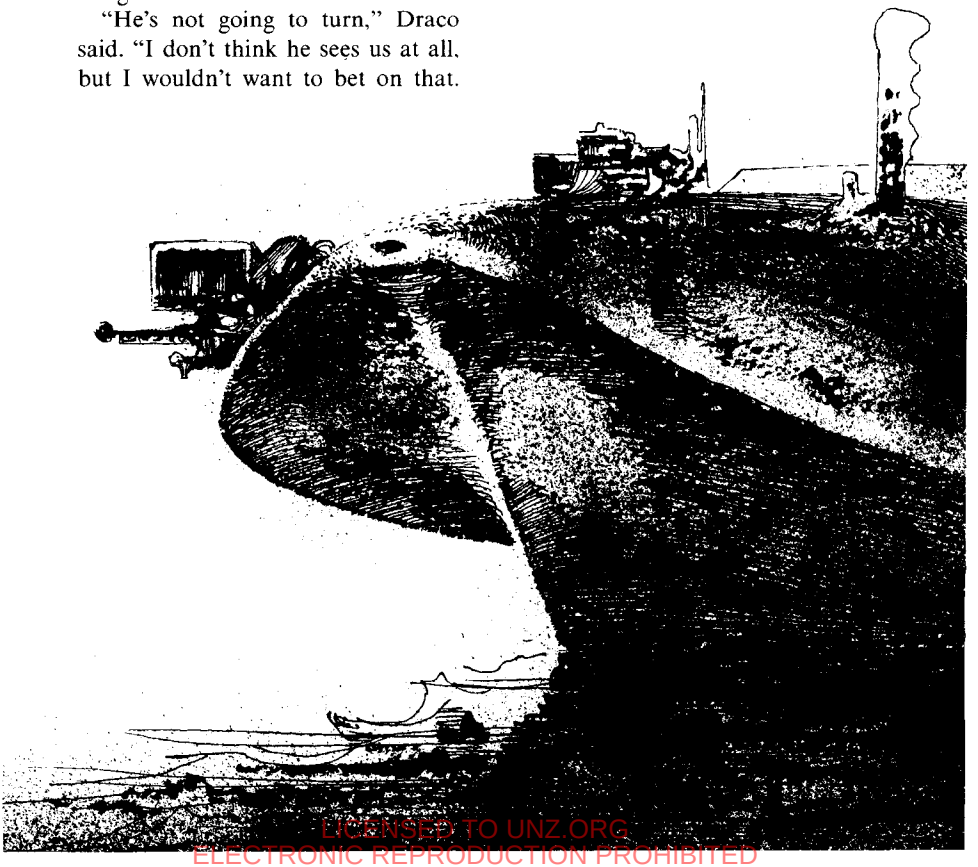
*Em Owl* kept on driving in toward the distant coast while the white wake and propeller spray of Rosarita Sam's boat crossed up the beach line without a waver or an attempt to dodge.

"He's not going to turn," Draco said. "I don't think he sees us at all, but I wouldn't want to bet on that. Take a look, Humph. Can you?"

Humph swung his head up, stared a moment, judging the speed and distance of the other boat.

"Better and better," he managed to say, in between his grunting swearwords. "He's boring straight by. I'll be in close enough to turn with him in a sec."

Despite the backed-down throttle, *Em Owl* was still running fast, surfing the following seas on the ragged edge of Humph's control. The distance



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closed rapidly; Rosarita Sam's gray and black boat became visible.

"Can you get any readings, Mike?" Draco asked. "This is about the best chance you'll get."

"I'll try," Michealston pressed switches on his panel. "Surely they would have packed any fuel pellets in sealed . . ." He broke off.

"Something?" Draco came alert.

"Barely. Neutron source. I'm just getting it on scale."

"A leaky container? Sam's a fast-boat man, not a nuclear physicist. Somebody packed a bum can?"

"Or they had a spill during loading. The boat may be hot, Draco. If they use it a lot then maybe . . ."

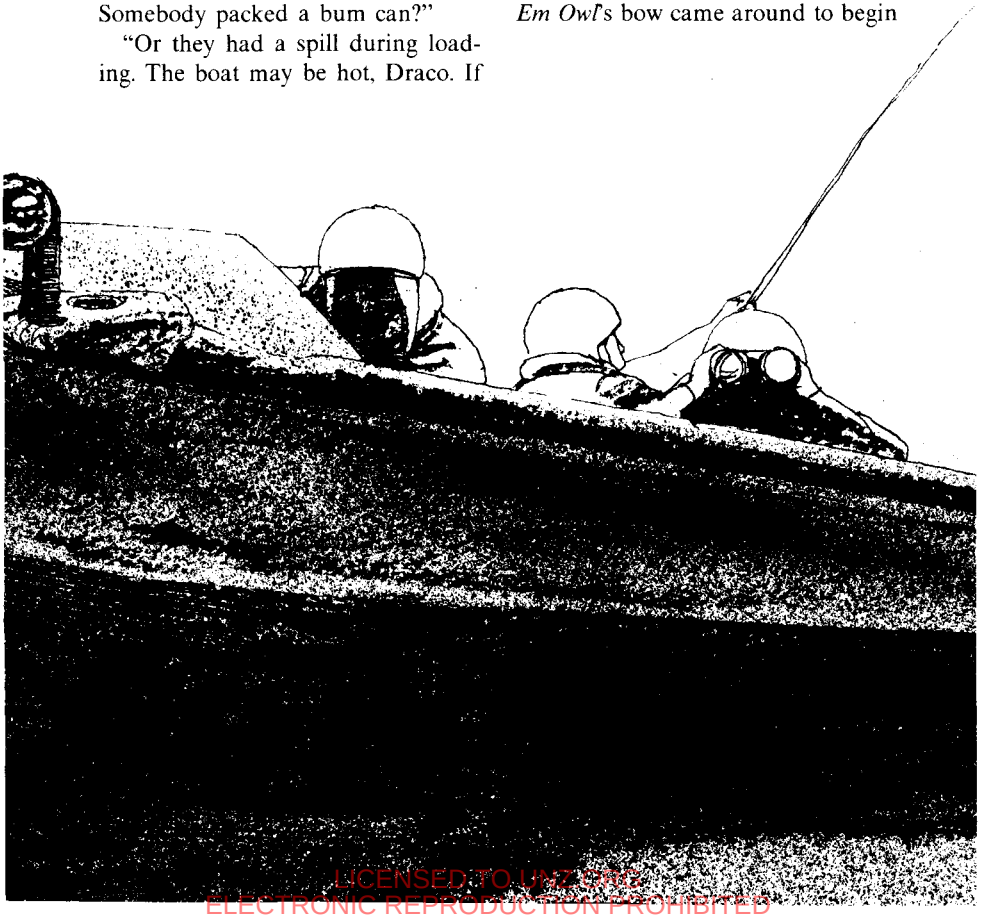
"Whatever. Your reading gives me probable cause to stop his boat anyway. It's enough.

"Move in and take him when you're ready, Humph."

"Shea-ah! What you think I'm doing?

"Hey! He's seen us. Here we go. Turning . . . port . . . now!"

Humph timed the sea swells and swung *Em Owl* into a sliding turn to port. He pushed the throttle forward, taking the twin motors up in rpm as *Em Owl*'s bow came around to begin



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knifing into the ground swell.

At the same time, ahead of them, nearer the beach, the geyser-feather of Rosarita Sam's boat flared high, doubling its vertical climb as the fleeing smuggler sighted *Em Owl*'s high-speed flag and started a full throttle dash. But now the flaring rooster tail was no longer white. The setting sun was tinting the flying water vapor a bloody pink, dancing rainbow spangles along the trailing spume as *Em Owl* bounced through certain angles.

Humph finished his turn and lined out behind the fleeing smuggler. He was right on his estimate of distance and angle. Rosarita Sam had crossed in front of *Em Owl* and was now leading the chase.

"He got way ahead," Draco said. "Lots of jump."

"Big E's. 120 horse," Humph said, referring to Sam's motors. "I count a crew of five though. Enough weight to make a difference."

"I have . . . much stronger . . . readings." Michealston gasped. "He is . . . hot. Neutron leak." His voice was bubbly.

Draco turned his head. Michealston's face was bloodsmeared—a battered nose that he kept wiping with one hand—but his eyes were bright and fixed on his dials. He was still operating, not seriously hurt, and there was nothing either one of them could do about the blood. If Mike kept on reading his dials so closely, the pounding boat was going to bloody his nose again.

"Geiger?" Draco asked, returning to business.

"Nothing. Too far." Michealston was ignoring the blood too. "IR readings must be their motors . . . or a fire. No—motors."

"Shea-ah! Hell!" Humph yelled. *Em Owl*, bucking into a quartering sea, dug her bow into a swell and swirled green water over the windscreen, flooding the cockpit and filling Draco's eyes and mouth with stinging brine.

The hull groaned and popped, noises felt through the seats and floor sections rather than sounds heard above the motor's screaming. Humph's voice in the headsets was a solid growl of profanity now, as he fought to recover from the impact, hold the racer rock-steady on her course. The slightest veer, at this speed, with the cockpit half filled with sea, and *Em Owl* would broach, spin flat out of control and explode into fragments. The sea was nearly solid at 70 mph and only *Em Owl*'s deep vee bow and keel were stressed to smash through the swells.

Humph held his speed as high as he dared until the cockpit self-bailers drained the boat's water load, then he eased the throttles forward. By careful timing he got *Em Owl* up on her racing vee and back to full throttle. She ran across the waves with her old brutal pounding, her bow headed straight at the smuggler's flaring rooster tail.

Humph's preplanned intercept course was working. *Em Owl* was



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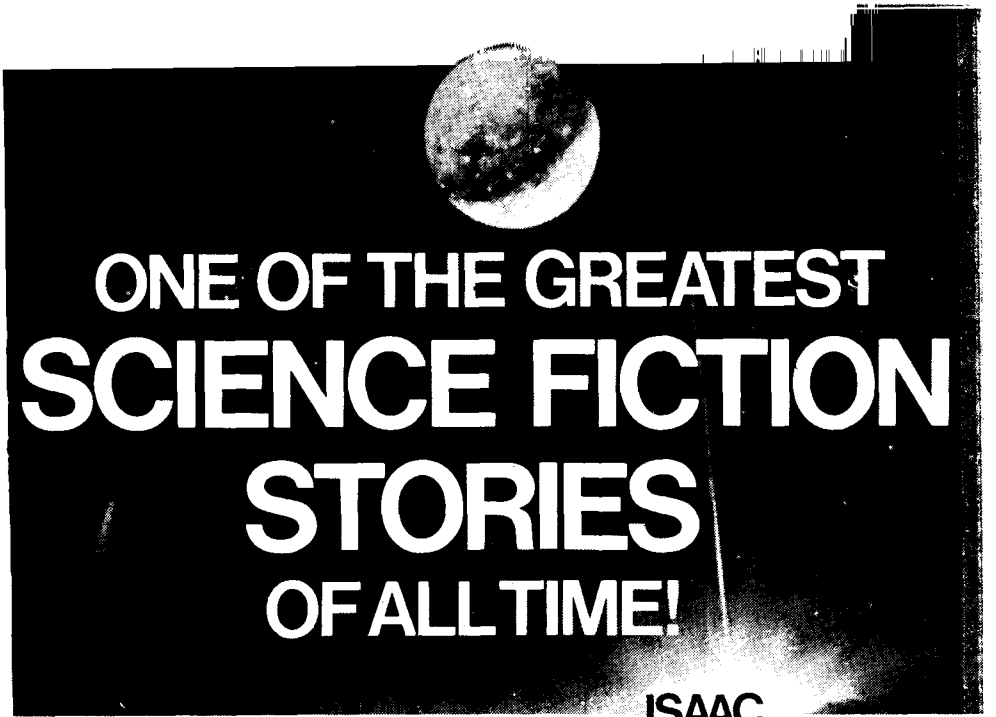


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directly astern of Sam's boat and closing the gap . . . that is, the gap closed to a long hundred meters and then stayed a gap. No combination of sea angle or throttle handling could keep *Em Owl* planing on her vee long enough to shorten the distance between the boats. At max throttle Humph could hold a full minute of planing, then *Em Owl* started to skip and buck out of the water, losing speed with her antics and forcing Humph to back down the throttle.

"No go. Shea-ah!" Humph said. "He's running right with me. I missed him on the coppin' turn."

"Close. Close enough." Draco gasped. "But we might as well be a mile away. He isn't going to stop and you can't catch him."

"Maybe . . . in a long run," Humph said. "My hull will run light better than that double-vee board he's using. Right now he's got less fuel than I do. He's faster . . . by just that edge. I can run him outta gas, Draco, but I can't gain on him. You got it all, buddy. Sorry."

"Well, maybe I can slow him down." Draco opened the pockets on his bag and pulled out a curved clip of three small rockets. He checked their yellow-nosed coding to be sure he had the right ones and loaded the clip onto the rear of the launcher. That took some doing. The dogs and quarter-turn Ordnance threads were designed for field and combat conditions, but the designers had never included a pitching, plunging, racing outboard in their tolerances. Everything was wet from the flooding and the flying spray; Draco hadn't even thought about a dry world since they left the cutter. The shuddering impact of *Em Owl*'s 5-g rise and fall as she hit the crest of a wave made the simple push-twist-lock-and-load procedure a major physical effort. Draco almost lost the clip overboard twice before the lugs were locked down into the trigger safeties.

The launcher had two ring-sights. Draco had kept them folded to prevent being impaled. Now, he swung them up and tried to aim. The crash helmet was good protection, it saved him from a major concussion each time his head was thrown against the launcher. The boat bounced and swung and battered him, but he could use the sights.

"Aargh! Let's do it," he said. "Come left a little, Humph. Drift him in my sights. Whaa-umph!"

"Uh huh." Humph made the course change. "Maybe you won't need that. He's gonna have to slow down to make delivery. San Onofre, coming up!"

"Huh? Heh-yaa! Back right. You went too far." Draco didn't dare lift his head. He'd never get it back in this position. The launcher hadn't hit him in a whole minute. "San Onofre?" The domes would be visible in the sunset. "Sam can't deliver at this speed."

"We're making better'n 75 mph."

"I'll slow him down!" Draco's voice was suddenly loud. He pushed



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a thumb against the safety and pulled the trigger three times.

The triple flash and flame of the rocket clip battered the cockpit. Michealston yelled as the pressure hit his ears and he saw the flame shroud the bow.

Humph ducked over his controls. Only the fact that the throttle was already fully open prevented his convulsive gripping of the lever from overspeeding the motors. He held the rudder steady from instinctive reflex, his head and shoulders hunched to shield his face from the flame, but his hand was rock-steady on the wheel.

*Em Owl* held on an even keel, rode through the streaming exhaust smoke, left it behind in seconds and flat-hatted down into a wave trough with a drenching splash—a splash that brought Humph back to his full-alert steering and brought a string of profanity about that "Coppin', flamin' rocket!"

"Draco! You can't shoot at them!" Michealston's voice was a tight, near-scream. "The fuel! You don't know what they're carrying. If it's plutonium, you'll poison the whole coast." He'd seen the splash pattern from the three rockets as they bracketed the fleeing smuggler's boat. "Draco, you can't explode those cans!"

"I don't intend to," Draco said. He'd wrestled another clip in place. "These are programmed for a five degree miss and proximity fused. They'll burst all around him. Turn him or stop him."

"Turn him. He's headed closer to the beach," Humph said. "You haven't fooled him a bit, Draco. He knows you won't blow him up. He's driving right through your . . . *good, God!*"

The smuggler's boat disappeared in a burst of red-and-black smoke. An explosion! Draco could see pieces flying through the air.

"A direct hit! He must have dodged right into . . ."

"We'll go on in and pick up survivors, I guess," Humph said, reducing his throttles. He didn't need full power now. "How about radiation, Doc? Can I go in?"

"Draco, there is no radiation count." Michealston's voice was coldly calm. He had been nearly hysterical when he saw Draco fire the rockets, but when the idea of a nuclear leak faced him, he was rock-steady, reading his instruments with sure competence. This was his field. "Nothing on the geiger or anything else. No neutron punctures or beta . . . there's nothing wrong in there. You didn't break up any of the containers. They must have all sunk. Not a trace.

"Wait! I'm back down-scale to where I was before." He looked up at Draco. "The same neutron source leak as before! The boat's still there!"

"I'll say she is!" Humph said. He shoved his throttles open again. "Tricked me. By damn! A bloody, coppin' smoke bomb. He tricked me."



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## A Calendar of Upcoming Events

**4-6 February 1977**
CONEBULUS (Syracuse area SF Conference) at Hotel Syracuse, Syracuse, N.Y. Guest of Honor—Gordon R. Dickson; Fan Guest of Honor—Jay Kay Klein. Registration $5 until 1 February 1977, $6 thereafter. $2 supporting at all times. Info: Carol Gobeyn, 619 Stolp Avenue, Syracuse, NY 13207.

**9-12 February 1977**
General Meeting of the American Physical Society and the American Association of Physics Teachers at Chicago, Ill. Info: W. W. Havens, A.P.S., 335 East 45th Street, New York, NY 10017.

**17-20 February 1977**
DESERTCON 5 (Tucson regional SF Conference) at Tucson, Ariz. Registration $5. Info: Desertcon, c/o University of Arizona, S.U.P.O. Box 10,000, Tucson, AZ 85720.

**18-20 February 1977**
BOSKONE 14 (New England Regional SF Conference) at Hotel Sheraton-Boston, Boston, Mass. Guest of Honor—Ben Bova; Official Artist—John Schoenherr. Registration $5 until 1 February 1977; $8 at the door. Info: NESFA, P.O. Box G, MIT Branch, Cambridge, MA 02139.

**20-26 February 1977**
Science and Change: Hopes and Dilemmas (143rd National Meeting of the American Association for the Advancement of Science) at Denver, Colo. Info: AAAS Meetings Office, 1776 Massachusetts Avenue NW, Washington, DC 20036.

**24-25 February 1977**
The Search for Extraterrestrial Intelligence at Ames Research Center, Moffet Field, Calif. Workshops on technology and sociology, anthropology, and psychology ramifications of search and discovery of extraterrestrial intelligence. Info: Ray Gorski, Director of Student Programs, AIAA, 1290 Avenue of the Americas, New York, NY 10019.

**28 February-3 March 1977**
CompCon—Spring meeting of the IEEE Computer Society at the Jack Tar Motel, San Francisco, Calif. Info: IEEE Meetings Inquiries, 345 East 47th Street, New York, NY 10017.

—ANTHONY LEWIS

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Rosarita Sam's boat belched another fireball and smoke-puff.

"I didn't shoot anything!" Draco said. "What the . . . ! He's firing at us."

"Look at the back of the boat," Humph said, when they finally got a good look through the smoke. "A Y-gun. He's throwing depth charges. Draco, my hull won't take . . ."

"The beach!" Michealston yelled. "He's bombing the beach. Look what they're doing!"

The Y-gun on Rosarita Sam's boat had fired twice and two heavy cans had arced in toward the beach. Stretched along a fifty meter length of sand and rock was a fluorescent red net, raised on poles and placed to catch and cushion the flying cans. In fact one had already landed, tearing down a section of the net in the process, but landing safely, unbroken. Draco could see the crew of men scrambling to cut it free and load it on the tracked truck. They were working in the net even when the second can came smashing and twisting into the shock-absorbing mesh. Some of them must have gotten hurt in that operation, but they were obviously in a hurry, working to a close-timed schedule. San Onofre must need those fuel pellets badly. Very badly.

Well, Draco needed Rosarita Sam badly. And now that he had dumped his load of radioactive fuel, there was no reason to be nice about the method of stopping him.

Draco spread open two more pockets on his bag. He had two clips for the rocket launcher with red-tipped nose fuses. He fitted one on the tube and leaned his head into the aiming position.

"Don't worry about catching him, Humph," he said. "Just line up on him like last time."

"Is that all he's going to deliver?" Michealston asked. "Two cans like that? Why they can't hold enough fuel pellets to keep San Onofre running for more than a month. All this work for two cans?"

"That's right," Draco said. "And next month I'll be out here chasing somebody else. Right now I'm going to stop Sam. It's just a job."

Rosarita Sam had turned away from the coast and was heading out to sea, making a run to where he had smoother water between the islands and could make better use of his planing hull. Humph slid *Em Owl* around in her high-speed turn and followed him, both boats bucking the incoming ground swells, driving head-on into the seas and still holding as close to full throttle as the water conditions would let them.

Draco caught the smuggler's boat in his rings once . . . twice . . . waited until *Em Owl* slid up out of a wave trough . . . and as the bow swung down toward the horizon . . . fired. The hull hit the top of the wave, bounced hard. He fired again, and again. The three rockets flamed out toward Rosarita Sam.

"Heat seekers this time," Draco said. "Can't miss."



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But the first missile did. It hit the water, a swell rising behind Sam's boat and the near solid column of his rooster tail. The second blasted through the exploded water column and impacted on the rear deck.

Rosarita Sam's motors and transom, a good quarter of his stern, crumpled into fragments of plastic. The motors tore loose and sank. His boat lost way immediately and began to fill with water. The third missile arrived and exploded on the port bow, completing the damage.

All of the explosions were silent blossoming flames, their sound drowned in the screaming roar of *Em Owl*'s motors.

The smuggler's boat rolled in the swells, settled stern down, twisted half-around and balanced with its torn bow sticking straight up in the air as it floated on the undamaged flotation cells in the hull. Rosarita Sam's gray-and-black paint job made the bobbing wreck look like some strange mating whale.

"That do seem to be that," Humph said. He had backed his throttles down. *Em Owl* was already settled down in the water, the forward curve of her bow rising easily to the ground swell, as Humph headed for the wreck. "Now we *will* go in and pick up survivors. If there are any. Doc, can you see where the Coast Guard boat is? They ought to be in on this."

"Coming in over there," Michealston said. "To the left."

Humph glanced in that direction and saw *Cape Victory* just as she was surrounded by the quick corona of spray that she made when she transferred from her hydrofoils to high-speed hull running. She was down on the water and still coming in toward the wreck, fast.

"They'll put a rubber boat in the water to help us look," he said. "But I'll get to the wreck first. Keep your eyes open. If there is anybody in the water that blast probably knocked them out. We ought to get to them quick."

The Coast Guard cutter launched its Zodiac with a rescue crew aboard, but Humph and *Em Owl* were closer. Michealston found the first man, floating face up, his life jacket torn open and holding his arms outspread. Michealston leaned out and grabbed his arm.

"Careful!" Humph said, cutting the big twins. "If that jacket comes off he'll take a dive on you. Draco, give him a hand. Forget that stupid launcher!" Draco had unshipped the launcher tube and was packing it out of sight. "Everybody knows you got it on board."

Draco unsnapped his belt and climbed over the seat-back to help Michealston pull the man into the cockpit, behind the seats.

"He's still alive," Michealston said.

"No," Draco said. He checked for a pulse, but he couldn't find one. "No."

"There's one who isn't," Humph said. "Starboard side. Got a hole in



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him and it isn't bleeding none.

"Take him aboard on the for'd deck, Draco. I can clean that. Don't want my cockpit bloodied up."

"You've said that before," Draco said. He crawled over the windscreen and lay flat across the long front deck to reach for the floating body. "We should have put on handrails." He grunted, and heaved the corpse on board, then got up to come back to the cockpit.

"Stay there," Humph said. "The Coast Guard's pulled a couple more out. We'll hand over our two. Too damn dark to move around without lights."

"That's only four," Draco said, when Humph maneuvered alongside the big Zodiac. "Hell, four. You said there were five on that boat?"

"Looked like it," Humph said. "Hey, Mac! Take these guys off me, will ya. I haven't got room for passengers."

The two Coast Guardsmen helped Draco transfer the men he'd rescued—one of them jumping on board briefly to help with the smuggler in the cockpit.

"Put a light on their faces, will you," Draco called, pointing to the two unknown smugglers in the Zodiac. "I want to make an ID." He looked, then grabbed Humph's shoulder. "Pull away, Humph. Make another sweep. Sam's not here. He's still missing.

"Sailor! Can you dive and look at the wreck? It won't sink. There's one more man."

Both Coast Guardsmen had wetsuits and facemasks on. One of them waved and rolled off the side of the Zodiac.

"Go, Humph! Come on. Move us around. I've got to find Sam. The whole damn exercise is no good if he gets away!"

"Gets away! Good God, Draco. You probably blew him to bits!" Michealston was white with the shock of handling the body out of the water. "I didn't plan on helping you murder five men. He drowned! Isn't that enough? You didn't stop him smuggling the fuel pellets, so you had to kill him. Is that it? God, Draco. You're just a killer. And for two cans of fuel pellets—one month of power—oh hell, Draco, that's only four ration days." He whirled to the side of the boat and was sick.

"Killer? For two cans?" Draco was searching out across the dark water. "Sure. Why not. It's just a job."

The sun was down now and the Zodiac was using a portable spotlight to scan the wreck. *Cape Victory* drifted in close and added her searchlights in a patterned sweep of the water around the wreck.

Humph was steering *Em Owl* in a circle toward the beach side of the wreck—the tide was setting in—so that he could see anything the lights picked out.

"The damn morons get scared that a nuke power plant is a bomb," Draco went on talking angrily to the dark water. "It will leak radioactive clouds, they say, melt down, poison



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the water, kill the sea life. So they pass laws that shut power plants down because they weren't safe. *Nobody ever asked a cop how to write that law*!

"So, the *law* cut down fuel production as a method to control power plant construction and size. The result? No blowups, no radioactive clouds—but no electricity either. We got brownouts and power ration-days and a roaring black market in contraband fuel pellets.

"Hell! Any cop could have told them that. Why can't a lawmaker ever figure out that *somebody* will do a crook on his law. Two ways from Sunday.

"She-ah!" He beat on the windscreen. "The only nuclear power plant disasters I've seen are dead smugglers . . . and blackouts."

"Might as well be bootlegging whiskey," Humph said, breaking into his mood.

"Right. We could drink the evidence like your Grandpop." Draco bounced out of his depression. "Let's go home, Humph." He decided. "I've missed him again. Pull over to the *Victory*. I've got to give the Captain some paperwork on those other men." He'd seen the diver get back on board the Zodiac and signal, *Nothing*. Draco slumped back in his seat.

"Maybe Doc's right; all I did was kill four men."

Humph didn't comment on that. He turned *Em Owl* back toward *Cape Victory* and used the big motors to make a short run up to the cutter's side. The crew had rigged the boarding stage again and the Zodiac was off loading the survivors—two stretcher cases—and two blanket-wrapped bundles. Humph waited patiently, then coasted in to tie up in turn. Two of the smugglers had lived.

"You think Sam's drowned?" he said finally when the bos'n tied *Em Owl* off to the landing boom.

"No way! Not till I see a body and check the fingerprints. Then maybe . . ." Draco shrugged.

"Well, get refueled. We'll head back in. The *Victory*'ll stay here and get Sam's boat towed in.

"Drowned? No. He got clear again. I'm kind of glad, I guess. He gave us a run, lots of times now. We'll have another chance at Rosarita Sam . . . someday."

Draco climbed out of *Em Owl* and went up the boarding ladder.

"You two make it sound like a stupid game," Michealston said.

"As long as people make stupid laws," Humph said, "and don't care where they get their electricity, that's what it is—a game. Ordinary guys like you and me just help out on the side. We don't play the game, so why horseshit about the rules.

"Draco runs the law; Rosarita breaks it. The game's called *Cops and Robbers*.

"Now get off my boat. Go find me some coffee and food. I want to gas up and get home. The game's over . . . for now." ■



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DOUG BEEKMAN

*Every growth in human capabilities brings a broader scope of choices, and challenges.*

***Eric Vinicoff***

# e-dep

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The sun was descending into its Pacific nest, setting the Golden Gate aflame. San Francisco prepared to walk proudly through the night, without its usual misty stole. It was a city wrapped in the past; a laden freighter sailed past its delapidated waterfront on route to Oakland. And to the north oil tanks were gaily-colored Easter eggs scattered across the Richmond shoreline.

Doctor Daemon Timothy enjoyed the view; from nature's perfection he could look down on the struggling works of humanity.

*I've been coming here more often lately. Too often. This need for detachment means I'm losing the empathy. I'll have to talk to Doctor Starlin, maybe take some therapy sessions.*

The evening was warm. He rolled over and watched the sky, peering into its deep blue secrets. He didn't want to get dressed yet. The long wild grass tickled his back, and the sensation pleased him.

*This trying to withdraw; what's causing it? I should be down there. With people. I need the experiences only they can furnish. Know thyself? I'm not Socrates; my profession isn't his. I must know them. How else can I stay fit to practice?*

He lay naked on top of the green knoll. Trimble had parked the copter unobtrusively somewhere beyond the strip of eucalyptus behind the knoll. Tilden Park in the Berkeley hills was the last natural wooded terrain in the Bay Area, a lone reminder of the past.

He felt momentary body-awareness. He was tall and thin, very thin. His bones stood out in relief; they could have hung him in an anatomy classroom. He wasn't eating well or often, despite his six-figure salary. Even in this attempt at relaxation his muscles twitched every so often and his stomach wouldn't untighten.

*I'm not making it. I've been sliding for months now, ever since Linda walked out. Cause or effect? Cause* and *effect; she came to hate both the work and me. Work. Me. Is there any difference now? It's a curse, and it's killing me.*

He sighed. Day or night, on duty or off; the Question always lurked in the suburbs of his mind. It warped his dreams, soured his life. It had driven Linda away. It cut him off from the human experience; his only friends were other E-Dep doctors. Only they could understand it.

The Question, unanswerable and never answered. But when it stopped asking itself he would have to retire. He wouldn't be fit to practice.

*Number six in UC Medical's Class of Eighty-One. Christ, I'm only twenty-eight!* But he felt a lot older, with middle-aged aches and horizons stopped down to F2.2.

*Over a quarter of the class is out of action so far. Eidelstein, Brunner, and Ma suicided. Von Hipp and Arnon killed by life fanatics. Olds insane and locked up in Menninger's. Peters and Lea serving ten-to-life at San Quentin for malpractice—one wrong Verdict and I could join them. Hayward,*



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*Tsaconas, Nelson and at least three others retired. Retired at twenty-eight? Devoured more like it; devoured and spit out by E-Dep.*

He sighed.

*Maybe now is the time. Time to retire. E-Dep has taken my life and returned only money. What binds me to this Faustian bargain? Masochism? An illusion of duty?*

"Doctor Timothy?"

He looked up. Trimble was standing over him. His chauffeur and bodyguard, they had been teamed for over three years. Trimble was about forty, cheerful, a family woman and a trained killer. *A mother-figure?* It wasn't a new thought. *Am I that crippled?*

Being naked didn't bother him. She had seen much deeper into him than that during their teaming. *She knows what I do. How can she stand being a part of it? I've never had the courage to ask her.* "Yes."

"A case call." Her usually bubbling voice was flat. "Grade Two."

He slipped into his tunic. *I've never had an actual Grade One emergency—anestheseologists can pretty much deal with any kind of pain these days. Dear God, I hope I never do.*

They walked down the knoll and through the trees to a small clearing. The copter was a stubby white two-seater with red ambulance markings. The irony of those markings never failed to cut him.

Trimble took the copter up and out over Berkeley. E-Dep doctors didn't have to stay at their hospitals while on duty—in fact AMA canons barred them from doing so, since it could tip the delicate balance of empathy. But they had to remain within ten flight minutes. If needed they were called. Case calls were rare, of course, but the expectation of one was a constant, grinding fear.

He looked down at the blue-green Bay water and scattered sail patches, and pondered the Question. Familiar enemy, faced again and again. Every time. Not answered, but faced.

*By what right do I do what I do?*

*Sure, there's technical comfort in Section 402A of Title Ninety of the United States Code; barring malpractice I'm acting under 'color of law.' But what about color of morality? Who legislates that?*

*Some accept it; some don't. Where do I stand? I know where I used to—four years at UC Medical, two of internship, the psychological exams* et al. *But where now, so many years and cases later?*

*I practice—but why? Inertia? Commitment? And if commitment, to whom—the patients or myself?*

Fog was rolling in from the Farallons, already blurring the remnant sun-half. San Francisco began to glitter with its night jewelry. It grew as the copter lowered. The hospital was at the Market Street end of Noe Valley, a gray block in the gathering darkness. Trimble had the radio siren on; no traffic cops bothered them as they dove through flight patterns.

The environment intruded faintly on his inwardly directed mind. The



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natural gloom became brilliant artificial light as a yawning alloy portal swallowed the copter. The landing was bumpy. Doors hissed open and shut as he walked. The smells of fuel and lubricating oil were replaced by an alcohol smell that triggered hospital reactions. The wide, bright corridors were filled with scurrying people.

*It's always a race here—with the fastest mount under the headless horseman. And I his squire?*

Trimble had stayed in the ambulance port, doing whatever chauffeur/bodyguards did while their doctors tended patients.

The people clogging the corridors were all strangers; a wall of purpose stood between him and the bustling hospital world. So alone, without any greetings to puncture his isolation, he came to the armored door marked E-DEP. The armed guards on either side of it nodded. They recognized him. But he still had to put his right eye in front of the retinascope screen.

The retinascope bleeped, and the bank-vault door swung open. He took one step, the hardest, over the threshold. Then he walked with forced confidence into the outer office. The door shut behind him.

*Guards and armor and scanners and guns. What insanity makes them necessary in a hospital? But they are. Not just to guard the ghost-sister, but also to save us from those who would murder us in the name of life.*

"Good evening, Daemon." Ms. Farber smiled up at him from her console-desk. "How are you this evening?"

"Lousy. I thought I was the backup doctor this shift?"

"You were. But Doctor Nivling got a psychological downcheck, so you're it."

"So downcheck me too. I feel disturbingly dispassionate. Almost detached."

She smiled. She was beautiful—a mask of vacuousness that helped her in her real work. "Tell it to the boss. But don't be surprised it it goes for naught; Catch 22, you know."

He nodded. "How do you keep your head when all about you etc etc?"

"Life and four daughters," she chuckled. "A fine prescription for perspective."

*It takes humor to last here, black humor. But there's rock behind it. There would have to be—being the buffer for E-Dep must get ugly at times.*

Ms. Farber was the secretary for E-Dep. She sent out case calls, handled visitors, took phone calls and did the paperwork.

She also chatted long and amiably with the doctors.

"You should be eating more," she told him softly.

"There's no one to cook meals for me since Linda left."

"So hire a cook; you've got the money. Or learn to cook yourself."

"No appetite."

"I'm not surprised—who could fit



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anything in beside all that self-pity?"

He stared at her sharply. The surprise attack, even launched as gently as possible, had hurt. "Et tu, Brute?" he whispered.

She shook her head. "Never a stab, Daemon—just a small prod from time to time."

He felt the cold wind blow away, then forced a thin grin. "It must be love. Why else would you bother with such a mess?"

"Of course I love you," she said seriously. "I love you all. For what you do and for accepting the cost. The—" A yellow light began to glow on her board. "He's off the phone. You can go in now."

The inner door opened. He went in, and it shut behind him.

"Evening, Daemon." Doctor Cardozo leaned back in his plush leather chair. He was installed behind a massive desk. The whole office radiated dark-wood-medical somberness, with no trace anywhere of less than total dedication. Daemon settled into a chair facing the desk.

"What's in the Theater?" he asked briskly.

Doctor Cardozo sighed and stared at the ceiling as though the answer was written there. "Julius Andrew Mohr. Twenty-six. A professional skimmer racer. Husband of Jane Lee Mohr. Father of two; Susan, age two, and Zenna, age one. Presently on full life-support."

Doctor Cardozo had been an E-Dep doctor before being promoted, of course. No *auslander* could possibly win enough respect from Daemon and his fellows to function. *How many times? How many times did he enter the Theater before being promoted?*

*Does becoming the department head answer the Question? Or just multiply it?*

"Is there any reason for a psychological downcheck?" Doctor Cardozo asked sharply.

This was all part of the game, but Daemon was too tired to play. "Nothing new."

Doctor Cardozo raised his brow. "We'll have to make sure, of course."

Daemon nodded wearily, rose and crossed to the dark alcove in which sat the dentist-chair telemetry system. He sat down. "Ready," he said. The alcove became dark as an alloy sheet slid down, isolating him from all sight and sound.

*Go ahead, Cardozo. Study your hidden displays. Decide whether I'm sane enough to cope with this one. But if you say yes, on your head be it. Because it gets harder each time. I'm losing the link.*

But Doctor Cardozo wasn't studying hidden displays. He had opened an intercom circuit to the outer office. "Well, Sharon?"

Ms. Sharon Farber, aka Sharon Farber, MD, Doctor of Psychiatry, *was* studying hidden displays. She was also mulling over every nuance and connotation of her 'chat' with



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Daemon. "It's a close one to call."

"How so?"

"He's on the edge of a classic martyr complex. Ms. Trimble's report worries me."

"That's bad. We can't use martyrs—they sacrifice for rather than relate to."

"I said on the edge. He's not there yet, and he may save himself—with some gentle prodding. He needs more human involvement. I'd help in that area myself, but Frank wouldn't like it."

Doctor Cardozo nodded to himself. "I'll see what I can do to fill your prescription. But what about tonight?"

"As a human being he's an emotional basket case. But in E-Dep maladjustment isn't just acceptable, it's essential. He'll stretch, but he won't snap—this time."

"So you check him?"

"Yes. I'll record and sign my report, and have it on your desk in a few minutes."

"Thanks, Sharon." He switched off the intercom.

The alloy sheet slid up, and Doctor Cardozo helped him out of the oversized chair. "What's the decision?" he asked, fearing either answer.

"No downcheck."

"So let's get to it," he growled. "Is he conscious?"

Pity averted Doctor Cardozo's eyes. "No."

*Ghost-sister! Each time the grip gets stronger! Each time the fascination of the link grows—and the incompleteness without it! Ghost-sister! Soon death will be my only way out!* He was shaking, and sweat stung his eyes into blinking fits.

"We have a good profile on him," Doctor Cardozo said hurriedly. He understood the pain, and he understood something worse—the actuality of life after retirement, the six months of intensive therapy to keep him sane during withdrawal from the ghost-sister. "The research people didn't have much time, as usual, but Mohr is a minor celebrity. The media has a great deal of material on him."

"What's the makeup?"

"Life history composite, Army psychological data, school transcripts through college, media coverage of his racing career and interviews with his wife, an older brother, and a fellow racer. A four aspirin load, I'm afraid."

"Is it all programmed?"

Doctor Cardozo looked at his desk displays and nodded. "The ready room is prepared." After an awkward pause he added, "I guess that's all. Good luck, Daemon."

"Thanks. Are you going to monitor?

"No—too much work to do. I'll study the tape tomorrow."

Daemon nodded, then went through the other door into the ready room. *Door after door, each leading deeper into the process. An assembly line ending in the Theater.*

The ready room was a realm of



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electronics; he always felt like an organic intruder. The motif was silver and white, bright with reflected fluorescence, and IBM blue trim. Colored dots and rectangles of light flickered on display boards. His heels sounded like gunshots as they rapped on the alloy floor, against the background of solid-state humming.

The room was small and empty. Technicians weren't needed, and their thinking would have interfered with the imprintation. He sat down in the Flash Gordon chair and donned the Buck Rogers helmet. The colored dots and rectangles danced in new patterns.

The room went to gray, then to black.

INSERT CORE 7AZ203.....GO..
xxxxxxxx(ADA clear)xxxxxxxxxxx
xxxxxxxxxxxxxxx(ADA clear)xxx
CORE INSERT-EX.end program

He groaned. Doctor Cardozo had been right; it was a four aspirin headache at least. But later. For now he would have to grin and bear it. He couldn't take anything, since other drugs distorted the effect of the ghost-sister.

But he knew Jay Mohr, knew him like a historical figure studied before a test—in detail but not personally. The imprintation was a short-term load. He would soon forget it. But now it was sharp; he knew more about Jay than he did about Linda.

*Loud and brash on the outside; burning on the inside. I can relate to that. Thank God. It's so damned hard when the psyches grate.*

*I just hope the imprintation tells it like it is. I don't think I could take another surprise like Ms. Harrington's homicidal mania.*

"Did the programming take?" a speaker voice asked.

"Yes." He nodded to the nearest camera eye. In the monitor room upstairs the questioner, a technician, was watching him on a holoscreen. Sight and sound were also going on tape.

"The patient is ready for you in the Theater. You can scrub and begin."

*Patient? Why that word? Why not victim?*

He entered the scrub alcove, gowned and washed up. Two of the three possible outcomes would require sustaining the sterile environment.

*But not the most likely one—or else I wouldn't be here.*

The final door opened.

He blurred his mind and walked in. He didn't want to think about what he was beginning.

The door closed behind him.

He was sealed under the Bell-jar dome of the Theater.

*Today and tomorrow and tomorrow—*

Thick walls cast a silent aura over the high-vaulted arena. It was operating-room bright, with gleaming white plastic and silver alloy. Medical equipment, mainly life-support apparatus, rimmed the wall. Two surgical couches sat in the center of



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the floor, side-by-side and so close that they almost touched. One was a portable life-support unit, joined by pipes and cables to the surrounding equipment.

On the unit lay a man.

In the unit, actually, since it wrapped him in tubes and wires, draped him with apparatus. In fact only his face protruded from the collage. The rest of him was a long lumpy shape under white sheets.

His eyes were shut, and his chest barely moving. His skin resembled erasable bond. "Good morning, Mister Mohr," Daemon said in a bitter parody of traditional bedside manner. "How are we feeling today?"

The man didn't answer, of course. Daemon hadn't expected an answer. His question bounced hollowly off the plastic, asking itself over and over. It also went on tape. Others would examine it in the morning.

He knew that too, but didn't care.

*Okay, Jay. Here's where we get down to business. No matter how deep you're hiding, I'm going to make the link.*

He walked over to a small hatch set in the wall beside a retinascope. He put his right eye up to the screen. "ID confirmed," the speaker voice yawned. "Your brain-juice is coming down."

Seconds later the hatch slid open, and in it sat a two-ounce vial of clear liquid.

He trembled. One half of him wanted to take the vial and throw it against the wall as hard as he could, wanted the liquid to splatter and die in evaporation, never to be again.

One half of him.

But he took it in reverent hands and carried it back to Jay Mohr. For long moments he just stood there, staring at the slack face, wondering what lay behind it. *Soon I'll know—probably more than I want to, as usual.*

Shrugging, he stretched out face-up on the other couch. His head was across from Jay Mohr's, less than a foot away. "I'm ready," he barked, fear sharpening his words.

"Confirmed." The speaker voice was briskly formal. "The telemetry system is ready. The emergency team is standing by. The Theater red light is on. Good luck."

He said nothing in reply. Instead he savagely uncapped the vial and drank the liquid. Then he threw the vial against the wall.

His left hand bridged the couches; the five fingertips leaned against Jay Mohr's shaved and bandaged scalp. The physical connection was vital, whether for reasons biophysical or psychological no one quite knew.

*They can imprint memory data; why can't they do this electronically and eliminate the need for the ghost-sister?* He knew they were working on that very problem, and hoped they would solve it before too many more lives were ruined as his had been.

Tetrothalitimocyanic acid. T-991. Brain-juice. The ghost-sister. And



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dozens of other names, spoken in scholarly conclaves and back alley rap sessions. More studied than any drug since penicillin, but no one knew exactly how it worked or what it did. Telepathic or empathic state? The reaction (when it came at all, which wasn't often since very few people were susceptible) was too subtle to define.

But, whether it let you think like your link-mate or enabled you to read his mind, the result was the same. And the power inherent in that result was dangerous enough to make the ghost-sister the most rigidly controlled drug in history. Its street value was incredibly high. The sentence for illegal possession was twenty years in state service.

Its only legal use was in E-Dep.

His eyelids closed, and he was trapped in the country of darkness. Sound, touch, taste and smell vanished. He was neither awake nor asleep. He wandered in the twilight universe of awareness without sensation.

*I . . . am . . . Daemon . . . Timothy. . . .*

Black without landmarks or street signs. Hunting. Groping. Reaching with tendrils of empathy for the lost one.

*I . . . am . . . I . . . am. . . .*

He knew what he was looking for, and why, but who was he? Memories faded; others came into being.

Where was the lost one? Deeper he dove through night, farther he reached.

The lost one had abandoned its once brilliant castle, the halls and corridors once lit by blazing consciousness. Now the great dwelling was dark and empty. Its master, tormented by pain, had sought refuge in some hidden subcellar.

*First love . . . in the meadow behind the dormitory—no! It was in the front seat of Jack's Porsche.* Acceptance; shifting without doubt.

Detection.

Mere wisps at first, but he grasped for more.

*Long hours of studying for . . . studying . . . working . . . in the garage. God sweat, the oil stink and the cold concrete against my back! Bloody two past midnight, but the birdboat has to be trimmed before the flag downs tomorrow!*

The link solidified. He drew close and fought for completion.

*Cut in the shiftstick—dip right. That's it! Bo's clearing out the inside track! If I can just get through, I can take it all the way!*

"Talk to me," he expressed.

No answer—shock and pain had silenced it.

He wasn't in tight enough. He felt for the discontinuities. He and it had to be one.

*Okay, now ease in—Stay back! We're going to crash it! NOOOOO!!*

He felt the pain, burned with it until all hell went bright red and screamed. But when the flames cleared, he and it were fully linked.

"You're frozen from the neck



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down," he expressed. "It can't be fixed. Your eyes are gone too. And your brain was hurt bad—you won't ever really wake up. Do you want to finish the race?" Its slang was his; he couldn't find the technical language that had once been so fluently his own.

A reaction rose into being, faint and purely emotional. The lost one was crippled beyond intellectual comprehension. But it absorbed the echo of his own emotional feedback from his message. It cogitated in some unknowable manner, at the surviving core of existence.

It reacted.

He focused on the output and probed for meaning. Faint, so very faint. How to find the subtle nuances of Verdict in such tenuous vapor?

"Help me," he begged. "I have to know. I have to find your road, the one you want to take. Help me. Help yourself."

An ember of the all-but-smothered fire glowed briefly. It had been a rage to experience, to fill all of life with its heat. But now it knew only despair and the bitter choice.

Telepathic voice or empathic echo? Either way the answer grew in his consciousness. A love of life soured, turned to fear of half-living. A vista of endless twilight. Then it blurred and faded.

The link shattered. He didn't try to hold it—the need was over. He suffered again, worse than the coupling pain; the empty ache of aloneness.

Back! Get back quickly!

Up and out!

Find the other world, the other him! Quick, before he lost them, as others had, to wander in darkness forever. Fear and hunger for life drove him.

Ripples spreading through the bubble, growing wider, reaching the boundary membrane. A touch and it bursts. Or does it? When the entirety is in the mind, who can say for sure?

Doctor Daemon Timothy opened his eyes.

He leaped convulsively off the couch and to his feet, the outburst characteristic of ghost-sister withdrawal. He was breathing fast and shallowly. Sweat soaked his body.

"Are you okay?" the speaker voice asked sharply. The telemetry readings were positive, but they couldn't detect the finer symptoms of insanity.

He nodded, staring down at the face of Jay Mohr. It was as it had been. Haunted.

"Verdict?"

He jerked at the demanding word, then moved on puppet strings to the retinascope and put his right eye in position. "Record and mark for ID," he whispered.

"Ready."

"I, Doctor—" His voice broke; he started over. "I, Doctor Daemon Timothy, licensed to practice in California by the Euthanasia Department, certify that the patient, Julius Andrew Mohr, with understanding



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of his condition and prognosis, has expressed a desire that we terminate his life-support."

The room shrieked ghostly recriminations, the spirits of all the others demanding revenge.

"Recorded," the voice said levelly.

*Damn you! You can't put all the guilt on me! You're a part of this too!*

He walked back to Jay Mohr, stopping in front of the life-support control panel. He forced himself to keep staring at the face; the young, human, alive face. His hands pulled away a protective plate that covered a keyhole. The key was on a chain

## Jack Gaughan

"J.K. has a fat camera," reads Jack Gaughan's autographed guest-of-honor photo in the *Program and Memory Book* of the 27th World Science Fiction Convention, the St. Louiscon in 1969. This is a touch more self-flattering than his assessment of an earlier picture I'd taken: "A dumb Irish mick!" Anyone knowing Jack would consider, "Irish, yes—dumb, absolutely not."

Jack's craftsmanship goes beyond just an art school background, personal tutoring by the famed Hannes Bok, and studying classic painters, illustrators, and engravers—the man is a student of art. And of science and science fiction. His library contains not only just about every conceivable art book of practical value, but also books you'd expect on the shelves of Analog's authors: illustrated texts covering mechanics, biology, astronomy, and other arcane topics dear to the hearts of science fiction writers.

A science fiction fan since his teens, Jack reads every story before illustrating it. He has received three Hugos for Best Professional Artist and one for Best Fan Artist. He is the only artist aside from Frank R. Paul to be a Professional Guest of Honor at a World Science Fiction Convention.

Born in Springfield, Ohio, and a graduate of Dayton Art Institute, he now lives with wife Phoebe 100 miles north of New York City in a house once described as "an old Lovecraftian manse," complete with bats in the attic. He had a successful career as an advertising artist, and even was art director of an agency, but happily turned full-time to science fiction illustration as a way of life. "I know and love science fiction," he wrote in the St. Louiscon program book.

Jay Kay Klein's BIOLOG
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around his neck; he put it in the hole.

He

*And he shall dwell . . .*

turned

*. . . in the house of the Lord . . .*

the

*. . . forever.*

key.

Lights flashed red on the panel, but he kept staring at the face. It appeared to sink a little. Then it came to ultimate rest.

*God have mercy on his soul. And mine.*

Pale interns entered and went to the body, giving him a wide berth. But he didn't see them. He saw only the face. Even as he left the Theater he saw only the face—one more to curse his dreams.

He trembled violently. Withdrawal would torment him for hours, and chain him for the rest of his life.

In Doctor Cardozo's office a large snifter of brandy awaited him. The office was empty—the department head knew the need for a solitary time after a link.

He collapsed into Doctor Cardozo's chair and put his feet up on the desk. In a few minutes he would return to the ready room and record his memories of the link for the review board. Then he would go downstairs to watch the perpetual balancing of forces. Then home.

In a few minutes . . .

Doctors James Ware and Arlene Koch were consulting on a parietal lobe tumor case in front of the 19th Floor nurses station, a reef amid the fast currents of hospital life.

Suddenly Doctor Ware nudged his companion. "Uh oh, look what's coming!"

Doctor Koch looked. So did others in the corridor, though many more were deliberately not looking.

Doctor Daemon Timothy was walking toward the elevators, apparently like any other doctor in his hospital whites. But they looked, even those who didn't know him or his profession.

He wore the mantle of E-Dep across his shoulders.

The aura of legal homicide.

A path opened for him in the crowded corridor. No one wanted to touch him.

He summoned an elevator and started down.

"I wonder where he's going," Doctor Ware muttered. "In his place I'd find the nearest bar and get ripped."

"He's heading down to Maternity," Doctor Koch said in a soft voice.

"Huh? I thought he was divorced?"

"He is. He just looks at the babies. Through the crib-room glass—he mixes with the fathers."

"What the hell?"

"After every, uh, case. I've seen him down there several times."

"I don't understand." Doctor Ware shook his head.

Doctor Koch's frown became a secret smile. "I think I do." ■



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# portions

## of this program . . .

*Improved understanding of how the human brain works*
*will* not *improve our understanding*
*of how the human mind works.*

***Dean Ing***

JACK GAUGHAN



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"At first the child lives in the present like the animal; however, he gradually breaks this fetter and learns to anticipate the future inwardly and to grope back into the past."

—Louise Taichert, 1973

"And you thought you were so cleverly metaphorical . . ."

—Miriam Deshong, 1992

Miriam Deshong sat cross-legged on the lab carpet, aware that the child was just behind her. Dish was certain that five-year-old Merry Mohr wanted her therapist to maintain the game. Even when she heard the faint familiar clatter of objects in her handbag, Dish denied herself the luxury of looking backward. That was why she could not see Merry approach, swinging the sharpened nail file.

Dish heard soft fleshy impacts but was not alarmed; an autistic child often chooses strange hand-games. Besides, Warren Lamar, behind the one-way mirror, was her backup. The senior pathologist would warn Dish if tiny platinum-blonde Merry Mohr were in danger.

Lamar had left his post for perhaps ninety seconds. He was pouring coffee from their battered percolator when Dish's anguished cry reached him. The pathologist dropped his cup as the steaming brew sloshed his hand. His first step was onto the fresh spill, which spun him onto the tile floor still holding the percolator. Slipping and cursing, he failed twice to rise before scrambling toward the observation room on hands and knees. Under different circumstances even Lamar might have laughed.

Dish didn't scream the first time Merry slashed her. She felt only slight pain, her blouse absorbing much of the damage. Before she could turn, the nail file connected again, scraping across her rib cage. Dish yelped, rolled away, and avoided Merry's next blow. Then she grappled with the slender girl. Merry, slippery with her own blood, slid easily from Dish. She then resumed her little game rhythmically stabbing into her small blue-veined wrist. She made no move to avoid Dish until the therapist grasped her weapon. Again she squirmed away but this time Dish had the nail file. Dish hurled the makeshift stiletto into a corner, half-expecting Merry to explode in the hyperactive chaotic rage of the autistic child. The temper firestorm did not come.

Warren Lamar burst into the room to find his assistant crooning through tears of pain and frustration, trying to carry the tiny girl from the room. Blood was seemingly everywhere.

Merry sat inert until Lamar tried to snatch her up. Dish saw—could almost *feel*—the rare return of Merry's awareness as the girl mewled and fought him. "Get her to the sink, Dish," Lamar rapped out, rushing off into the lab. "I'll call Matson!"

Dish heard Lamar's rapid-fire ex-



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change with Matson's secretary. As institutional research director of the university, Dr. Charles Dana Matson rarely played the M.D., but it was nice to know the bastard had his uses.

As small as the lab sink was, it made a bathtub for little Merry. Dish cleansed the small ravaged hand, fighting shudders at the sight of the open punctures, while Merry focused with calm intensity on splashing her free hand in the water. Dish felt Lamar's presence at her elbow and glanced around. "Matson coming? And," she flared, "whatthehell are you smirking about?"

"Relax," he said, reaching for alcohol swabs. "Himself is on the way. And sorry, but check your face in the mirror there, and then look at Merry's."

Dish saw her own features, framed by the luxuriant bronze mane. Basically a good thirtyish face, firm mouth with a slight tarter tilt to the gray eyes. But she was squinting and her lips were pulled back: classic pain behaviors. Merry Mohr's silvery-blonde hair was blood-matted, but her face was wholly composed, lovely, intent on her play. With an effort Dish reshaped her own expression. "I can't help it, Warren. She may not hurt but *I* do," she muttered.

Lamar nodded and applied a swab. "Well, if you feel woozy you can—oops!" He held Dish erect from behind as, legs shaking, she slumped in slow motion against the sink. Lamar did not take Merry from Dish. Merry was calm in Dish's arms as the therapist, leaning with elbows in the sink, was supported by Lamar. If the tiny girl refused his touch, he could use Dish as go-between.

Moments later, Dr. Matson found the trio still grouped at the sink. Chuck Matson moved with a hint of bounce that irked most of the faculty, especially those in middle years who did not, as Matson did, make a point of physical conditioning. His voice assumed its usual authority: "All right, Miriam, I'll take her. Um. Well, this little lady is lucky—doesn't look like any serious damage." Matson kept up the spiel, working on the silent Merry while risking glances at Dish. Warren Lamar began to clean the floor. "In fact, Miriam, I'd say her color is better than yours," Matson smiled faintly.

"Don't rub it in, Dr. Matson. I just empathize so much with children—my specials most of all."

Matson grunted, then quizzed the therapists on the accident. They freely gave details, Lamar volunteering blame for leaving the observation window.

"I don't expect perfection," Matson replied, finishing a suture clamp, "but this is the fourth injury this season to one of your autistics, Miriam."

"My *special children*," Dish implied the correction, "have special problems. They get hurt here less than in their own homes."

"Besides which, you have releases from Merry's parents," Lamar put in.



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"The university isn't liable."

Matson shrugged, finishing the bandage. "I was thinking in terms of blood, not dollars. I'm an administrator second—and general practitioner last, to judge from this bandage. Maybe I should be glad you two keep me in practice." Matson faced the angry pair with absolutely no readable expression, a legacy from years of riding herd on psychologists. "You research people are so defensive! If I didn't approve of your work, you two wouldn't get some of those research grants," he amended.

"We're getting there," Lamar replied evenly. "I'm a straight Skinnerian but Dish here keeps coming up with wags about programs for these kids."

"Wags?"

Dish snorted, a sign that her composure was returning, and stood erect. "W—A—G . . . wild-ass guess—Warren's term for any hypothesis that probes into the so-called black boxes of a child's mind. Take King Smith, now . . ."

"And condition him as a Harlem Globtrotter," Lamar cut in with forced humor. "Let's test our wags out, Dish, and *then* talk about 'em."

Dish saw behind Lamar's easy smile and made an eyebrow. *He's right,* she thought, *there's a right time to spring mind-bending new ideas. And seven thousand wrong times.* She drew a deep breath, felt the scrape above her kidney, and staggered. Matson's repairs were only half-done.

Under Matson's sedative, Merry Mohr was tractable as a puppet. Dish's wounds were only superficial, with no clamps necessary from the hand tool which Matson could use almost like a stapler. Within the hour Dish and Lamar, with a student assistant, had the lab in shape again. They made explanations to Merry's mother at pickup time, then spent a final session reviewing videotape records of King Smith, a profoundly autistic black child whose behavior patterns were disturbing in a very special way.

Freezing the video on a frame, Lamar studied the elapsed-time rig. "Eighteen minutes and some seconds again," he said. "You'll hate this, Dish, but we need to program some experimental frustrations on King—just backup data."

Dish pointed at her calculator display. "Haven't you got an ethical bone in your body, Warren? We have enough hard data *now* to publish results. King Smith has an intermittent eighteen-minute feedback loop in his head and that, probability point nine-nine-five, is that. Why punish the poor little guy on purpose?"

"Higher statistical confidence level."

"Any more assurance than we already have would be statistical masturbation, and you know it."

Lamar frowned at the video. It



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framed a scene recorded in the special children's playroom that day by automatic cameras slaved to follow the transmitter on the back of King Smith's belt. The gangly six-year-old played alone even among other children. Bereft of speech, seemingly blind and deaf at times, King might develop a sudden interest in a toy another child was using. Often King simply took it, the other child shrugging off the invasion as one might accept an act of God. This time it had been different: the offended boy had punched King squarely if clumsily in the mouth, then ducked away. Lamar's video frame held a full-face shot of King, the handsome broad-nosed little face as expressionless as an administrator's even while the other boy's fist snapped his head back.

"Right on the button," Lamar mused. "If that isn't a pain stimulus I'm a Matson's uncle." And eighteen minutes later on that videotape—Dish's prediction was correct—came King Smith's sudden response to—something. Something very like a wallop in the mouth.

For many years, therapists had classified grossly inappropriate responses as elements of the syndrome called autism. While some children responded to certain regimens of behavioral engineering, others remained untouched and lost within themselves. It was taken for granted that autism might have several functional bases, any of which might yield that small horror,


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autism. A lone child, monotonously tapping two blocks together, might suddenly begin to duck and dodge, or be overwhelmed by tears, or rage. Clearly responses—but to *what*? To the objective world, that response was inappropriate. Usually it was impossible to query the silent, impassive, uncaring child who could not or would not commune with others. For the most part, the autistic child lived in a world exclusively, heartbreakingly, his own.

Then one day as Dish vainly tried to interest him in a simple tactile puzzle, King Smith had grabbed a wooden piece and swallowed it—or almost. He then sat inert, gradually turning brownish gray, finally slumping from anoxia as Dish extracted the



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block from his windpipe. Dish used mouth-to-mouth procedure, a dangerous process when applied to a child half doll, half wild animal. She anxiously watched the paled skin flush to healthier tones, and noted the time.

Shortly thereafter, Dish was in conference with parents of another child when Bill Fletcher, the student assistant, burst into her office. "It's King Smith, Miz Deshong," he burst out. "He must'a swallowed something!"

It took a fast, chancy fluoroscopy to convince Dish that King had swallowed nothing. His performance had been convincing enough: thin fingers scrabbling in his mouth, eyes wide, terrified little lungs pumping as fevered bellows. Presently he quit this inappropriate behavior with startling abruptness, and Dish was too relieved to think beyond the moment–*for* the moment.

Later, Dish described her experience to Lamar. "Now that I think of it, his lungs were working beautifully," she said. "I was too freaked out to realize it but there couldn't've been any serious blockage in the trachea." Suddenly, in a luminous flood, the memory of King's earlier experiment with the toy blocks washed over her mind. "Anyway, I was trying a new tactile program with King–ah, what was I saying? And, ah, portions of this program . . ." She trailed off, thinking hard on a shining concept new to her.

". . . were prerecorded," Lamar finished laconically. "Dish, you have that glazed 'eureka' look again, it always . . ."

Dish raised both hands to her cheeks, mesmerized with the thought. "Well you sarcastic son of a bitch," she breathed, eyes elated. "And you thought you were so cleverly metaphorical–but if it's true, what do we *do* about it?"

"Whaddawedo about *what*?"

It took Dish ten minutes to convince Lamar she was serious, and another ten days to separate him from the notion that she was hallucinating. Gradually, using automated videotape tracking of King Smith in daily playroom routines, Dish built a case for a delayed mental feedback loop amenable to cybernetic theory.

When King Smith walked into a cushioned wall, or fell hard, or was forcibly restrained from some dangerous behavior, he might respond instantly. Or, especially if the jolt was severe, he sometimes took the stimulus with absolute calm. And sometimes, eighteen minutes after failing to respond, King Smith would burst into frantic, violent action which would have been appropriate eighteen minutes earlier. They spent weeks amassing data, Dish impatient, Lamar increasingly cautious and slow.

Now, glaring at the display, Lamar slapped the console switch off. "You're right, Dish. Some of his sensory inputs are going into a reproducible holding pattern. No point in foot-dragging, we can present this



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stuff and get a special grant." He whispered a popular tune off-key, the usual tipoff that his formidable circuits were busy.

She was loath to interrupt him, but: "I hope you aren't going to propose an aversive stimulus program. It isn't necessary."

Lamar broke off quickly, swung from his chair, and snatched at a mighty yawn. "Right on, luv." Dish despised every nuance of their old phrase but ignored it. "We need a paradigm of that intermittent feedback loop, probably an *n*-stage synaptic amplifier with low acetylcholine balance somewhere after state one. If we have a model of it on paper, it may give Chris Maffei a hint on how to modify it chemically. And if he can do that on a predictable schedule . . ." He spread his hands in a show of enthusiasm which Dish found herself doubting.

"That's a pretty glib analysis," she probed, "unless you've been convinced all along. Think there could be a better explanatory model?"

"I'll think about it on the way to K.C. There may be something in the literature, maybe old Cronkhite's 'Strangers in Paradigm' monograph. You might digest some drug therapy stuff; ah, maybe start with Berger's work about thirty years ago, say, 1960." He paused at the door, donning his tattered driving gloves. "Or you *could* have a drink with me."

The previous year, Lamar would have taken that drink for granted, and so would Dish, who had begun an abortive affair with him soon after her arrival at their midwest campus. But if Dish admired the stolid behavioral engineer's side of Lamar, she longed for some sign of emotional warmth in him. She could never find it. The night she dreamed she was in bed with a machine, Dish awoke in cold sweat, dressed, and left Warren Lamar's Kansas City apartment without waking him. She never went back. It was characteristic of Lamar that he did not complain, never demanded an explanation. At the university, forty miles from the city, they still worked well together. For this Dish was silently grateful.

Yet, "I've got some books to flog," she lied, adding impishly, "and you've got a randy look about you."

"My title is *therapist*, not *the rapist*."

"The only difference is in spacing," Dish said to his departing figure. Then she began to ponder a new hypothesis about Merry Mohr. She wasn't ready to hit Lamar with this one, God knows he was reluctant enough to accept the obvious in King Smith's case.

Merry, however, was another side of the coin. Dish herself scarcely dared to entertain what, she felt, was the most waggish of wags. With a great sigh, Dish began to review videotapes of the play periods featuring Merry. To avoid missing the last monorail shuttle across the gully-wrinkled plains to Kansas City, she'd



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have to run an accelerated scan. This had an unpleasant corollary: a pounding headache. But she had to be sure.

Five minutes later, Dish's gray eyes were smoky with anger. Her first impulse was to squander money on the fast taxi lift from campus to K.C., find the oh-so-careful Lamar, and lash him for being a thirteen-thumbed *schlemozzle*. But she had made stupid mistakes herself; there had to be a first time for Lamar. Dish secured the lab and walked to the shuttle dock wishing she, like Lamar, had a sporty electrabout three-wheeler. Driving it might have erased the awareness that somehow, idiotically, Warren Lamar had made his own erasure—the essential afternoon segment of Merry's videotape.

Dish had little time, the next day, to complain about the erased tape. First came a group of student assistants and their briefings for subprograms she ran for Lamar. Then a class in phonetics, followed by words with her chief assistant who wanted to take Merry Mohr, bandages and all, to a test room on Lamar's orders.

"I'm sorry, Bill," she said firmly, "Merry needs no stimuli, if we can help it, for the next few days. Doctor's orders."

The youth moved on one foot, a parody of indecision. "Well, you're the boss, Miz Deshong, but Mr. Lamar is bosser, and if we miss a session with Merry he's gonna take my head off at the waist."

Dish repressed her grin with a cough that fooled no one. "And if we don't, Dr. Chuck Matson Himself will tack our collective hide on his office wall. He's the doctor, and them thar's the orders. Bill." She excused herself and rushed to the staff meeting with other factions of the Speech Department. Therapists and thespians mingled in the same department, which still administered programs from frontal lisp to Freudian dialog. Dish occasionally sat in on debates and drama tryouts. Lamar generally sent Dish to meetings, claiming seniority. It was a dull meeting; Dish got her entertainment on returning to the lab.

"Deshong, keep the hell out of my experimental programs," was Lamar's greeting as she closed the thick door. Something in his voice made Dish look twice. She had never seen Lamar truly angry or frightened, but there was something of each in him now.

She flicked her babushka away, unconsciously preening her hair for him. It was an expiation but Dish did not know her sin. "You mean Bill Fletcher and Merry? You know Matson's orders. I supposed you'd forgotten to tell Bill. I don't know what you're doing but . . ."

"But you countermanded me anyway," Lamar gritted. "Next time, don't. I know what I'm doing." He swept perspiration from his temples with both hands and continued, but with a sudden shift to softer tones.



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"Maybe we should take it up with Matson. D'you think we can confide in an M.D., administrator, health nut, politician, et cetera?"

Dish was about to say she was damned if she knew when a silky baritone from the corner startled her, literally, speechless. "I wouldn't. Nor anyone else yet, Warren." He lazed astraddle an old chair, his forearms folded over its top. Dish's first impression was of a stocky graying man with outsized sinewy hands. Then he stood up. He was taller than Lamar by several inches and, uncurling from the chair, he seemed to have fluid drive. "I'm Neil Fox," he said, moving to her. His handshake was completely unaggressive.

"Miriam Deshong," she responded. "Take *what* up with Matson?"

"First things first," the newcomer said, palms out toward her, his smile gentle, beatific.

*My God*, Dish thought, *this is one attractive cop—and why do I think he's a cop*?

Fox went on in his soothing, steady pace: "First, my name is Fox only so long as this surveillance lasts. Next, I could show you my ID but you cannot confirm it. You'll have to take Mr. Lamar's word that it can be confirmed. Will you?"

Dish frowned toward Lamar, whose expression, over folded arms, was part leftover irritation, part smugness at her confusion.

Dish gave Lamar an old, old look, a questioning gaze of confidence and affection sculpted from memory. She could see its effect on Lamar. *Gotcha*, she thought, *I can play dirty, too*. "Can I take your word, Warren?"

"Absolutely," he managed to say, struggling to decipher this strange woman's ways.

Dish turned a dazzling smile on Fox. "I take it that you're police of some sort."

Fox's smile slowly broadened, saying volumes in nonverbals Dish could not quite read. The linguist in her scanned his accent—neither foreign, nor mainstream, and not moneyed, but arrogant, alert, busy—a metropolitan dialect. She gave up trying to place him as Fox answered, "Of some sort. Really, it's a routine—even picayune—matter. The agency helps fund some scholarly research, and once in awhile we find more than one group working on identical problems. It may be happening here. Don't worry, we won't take your money away." A chuckle of confidence. "But even more interesting, you may have some data on sensory delay that could conceivably be of, ah, national interest."

He cocked his head, a faint request for response, and Dish saw the play of light on gray-black sideburns, recently trimmed. A *most* attractive cop. "I'm glad of course," Dish stammered, "but what can I—we—do? Or have I done it?"

"You almost done it this morning," Lamar aped her delivery, "and we'll be much obliged if you don't do it again. I'm running programs with



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some kids. Merry what's-her-name, Mohr, was one of 'em. For the next couple of weeks just cover for me, Dish. Don't let anything screw up any of my sessions with the kids. That's all."

*He knows Merry's name as well as I do,* Dish thought. *Is he playing coy with Mr. tall-dark-and-craggy?* "You're the chief therapist," she admitted. "I just hope the university likes the explanations you give when it's all over. I hope I do, too."

"In due time, Miriam," Fox soothed. "We don't like to complicate things more than we have to."

Lamar put in, a bit too quickly, "And you may be helping a whole lot of kids, not just a few."

Dish nodded in a forced show of confidence. "Speaking of complications, Warren, did you digest the stuff I laid out for you on Deaner?"

"Someone I don't know?" Fox asked. The notion did not seem to please him.

"A chemical," Lamar explained. "Diethylaminoethanol; which is a good reason to call it Deaner. There's a pharmacologist M.D., name of Maffei, who has better stuff. Best of all, Chris Maffei lives within shuttle distance, in Omaha. Talked with him earlier, and he's happy to work with King Smith on our IOU, at least until your people get my grant request by normal channels."

"I've heard of Maffei," Fox said wisely, approvingly.

"Will the Smiths let King go to Omaha?" asked Dish.

Lamar savored the moment, then: "They came for him this morning. Maffei's arranging it at his end. Rest easy, Dish." His grin was one of genuine pleasure.

It may have been gratitude that prompted Dish to choose that moment. "I have some news, too. King Smith isn't the only kid with a sensory temporal displacement."

In the momentary silence that followed, Dish felt a chill run from hairline to fingertips. It was not all anticipation; Lamar and Fox waited with identical catatonic expressions. "You're going to think I'm freaked all the way out and back again," she said, then realized she was stalling. She rushed on, "All right, here's what started me thinking. A few days ago, Merry Mohr was in the playground when she ran full-tilt into a wooden pole. She lay there for almost a minute, but before I could cross the playground, she was up." Dish grimaced at the memory, then wailed, "And she ran into the goddamn pole *again*! She didn't respond to either impact. I put her under observation, but I guess she wasn't any more gaga than usual.

"So later, I'm studying a videotape of free play when I see Merry sitting quietly, playing with a piece of string. Suddenly she bursts into tears and claps her hands to her left temple. And while I'm watching this so-called inappropriate behavior die down—this syndrome we take for granted, dammit, you know we do—she jerks her hands to the right a



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little and uncorks another fit."

No change from Fox or Lamar. Both might have been statues. Dish took a deep breath. "When I checked the time-pulse on the video I couldn't believe it. Merry's delay was thirty-seven minutes long, but *it was in the wrong direction*. Warren, Merry Mohr felt the blows a half-hour before they happened! And I think she's done that lots of other times, but I haven't been able to spot 'em yet. I will. I'm ninety percent certain Merry has a feedback loop; only it isn't feed*back*." She chirped a laugh at the two men who seemed guided by the same puppet master. They were both slightly openmouthed now. "Warren, it's—it's a feed*forward* loop! I swear it is."

"Absurd." One corner of Fox's mouth twitched up, the spell broken. "You're joking, Ms. Deshong."

"You're putting on an old on-putter," Lamar chimed in. "I've modeled the Smith boy's loop as primary and secondary synapse chains which everybody may have, but King's secondary doesn't always fire on schedule so the stimulus input is stored as a sort of precognitive labile memory until . . ." He trailed off. "Well, Maffei and you will both get copies. And this, this feedforward loop won't fit that paradigm at *all*," he said. He punctuated the complaint by chopping at the air in frustration.

Dish laughed ruefully. One corner of her mind marveled at Lamar's ability to grasp, in seconds, new concepts. "Okay, I'm weird," she said. "Call it just a hypothesis. But I think I can prove it in a few more days. Today a hypothesis, but . . ."

"Tomorrow the world," Lamar grunted, then flashed a glance at Neil Fox. "Just repartee," he said weakly.

If Fox had been startled, he was quick to recover. "I think we'll be happier with a circuit paradigm of feedback than with the, ah," he paused and enunciated carefully, "bizarre claims of time travel. It's not the sort of claim you make without a long and leisurely study."

Dish knew she'd handled it badly. Lamar angry, Fox contemptuous, both hinting that she played her mental cards with half a deck. "Maybe you're right," she said. "I can't really believe it myself. Look, I—I have a lunch date." She retrieved her babushka, retied it, and opened the lab door.

"Dish Deshong, my autistic adult," Lamar repeated an old affectionate insult. "It's the wildest wag you ever had, but it has charm." He grinned. "King Smith hooked up to a while ago, and Merry Mohr with a hookup to tomorrow."

"More like half an hour," Dish replied softly. "Nice to meet you, Mr. Fox. See you, Warren," she promised.

But Dish could not keep that promise.

Dish knew her lie of the lunch date was transparent and did not much



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care. She felt only relief when young Bill Fletcher, moving at his normal breakneck pace, brought news that she would be taking over Lamar's afternoon lecture. The senior pathologist, it seemed, would be off-campus with his visitor. Dish covered for Lamar, took on her own usual duties, and blessed the chime announcing the end of classes. Perhaps now she could begin the tedious videotape reviews that might verify Merry Mohr's incredible deviance.

The videotapes were blank.

Dish stood at the tape storage bank for long minutes, mute and numb. She eliminated every impossibility, and was faced with the stark certainty that only Lamar, who alone with Dish had the code to the high-speed erasure mode, could have destroyed months of audio-visual recordings. It could not have been an accident. God *damn* Lamar, coldly and logically forcing her to obtain new data! Warren Lamar's lexicon did not include the term *fair*, but he was always cautious and professional. Always until now. She felt hot tears on her cheeks and let them come, stumbling about the lab to secure the place, enclosing herself in a cocoon of misery. It occurred to Dish that her respect for Lamar was a cornerstone of her work, and it was crumbling under his wanton shortsightedness. If this was his way of dissuading her from a peculiar wag, it was nothing short of childish.

She left the campus by shuttle, walked under a crisply clean evening sky to her apartment, and went from Drambuie to books to stereo to sleep. None of it was very restful.

She overslept, of course. She accepted puffy eyes and a stomach that took to its trampoline at thoughts of breakfast, and Dish barely acknowledged familiar faces on the shuttle to campus.

Halfway through the ride, Dish snapped from her dark reverie. Most of the passengers were university people, intent on the overhead video, where a reporter's voice-over gave brisk details of a pictured freeway smash.

". . . impact was so great that the victim could not be freed immediately. Debris from the electric two-seater forced rerouting of private vehicles from the air terminal interchange.

"No other vehicle was involved in the early morning crash. Officials noted that Lamar was licensed for manual control, and stressed the need for more stringent regulations."

Outwardly she was calm. Acquaintances were watching her. There were thousands of Lamars in the area, no doubt, but she knew with leaden certainty that she would never singe Warren's ears, now. He had paid dearly for his beloved manual control; first in taxes, and now—. And she had seen the iridescent sun-yellow glint from the shattered electrabout: the color Lamar chose. Dish bit her lip, closed her eyes, and feigned sleep until she reached the campus.



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The department chairman, Dr. Bishoply, was in the Speech Path lab when Dish walked in. He assumed from her appearance that Dish had been crying and misunderstood her motive. "Miriam–Dish–I took the liberty of canceling your appointments this morning. I . . . oh, *hell*, what do I say," he moaned, turning half away. He was not a large man, nor always very strong under pressure. But unfailingly he did the very best he could.

Dish felt a surge of affection, even pity, and croaked out her thanks. It did not sound like her own voice and with instant objective clarity Dish saw herself miserably broken. And by what? A heartless, self-serving cheat snuffed out halfway through a new dissertation in dirty tricks. Finding her anodyne in anger, she masked it. "I'll be okay," she said, vowing to make it true.

Bishoply nodded. "And when you feel like it, come talk with me. Galling as it is, we have to pick up a lot of pieces." He left quickly. They had not even obliquely mentioned the fact that her hated, beloved Warren was dead.

Dish shook her head free of the thought and began to collect Lamar's lab notebooks. She was composed enough to watch the 9 A.M. newscast. There was no doubt whatever that Warren Lamar had marmaladed himself against an interchange abutment ten miles from Kansas City just before dawn. The official statement was faintly self-righteous in citing a combination of alcohol and marijuana. It was official–a dead man, a dead issue. *Maybe it's official*, she thought, *but it isn't all true.*

Dish was glad of hunger pangs that took her attention from the newscast. Maybe she could promote some scrambled eggs at the faculty club. She forced a smile at the children as she strolled past the playground. Merry Mohr, her plastic bandage raveling to lend her a waifish look, followed Dish with her eyes but did not, of course, return the wave.

Dish was comforting herself with plans for Merry and chasing a scrap of egg with her fork when the adjacent chair was whisked away. When it returned, Matson Himself occupied it. Dish fought an urge to flee and continued to persecute her egg.

Matson slouched back and regarded her for a long moment. "One helluvan egg to justify all that industry," he offered.

Silence.

"Pulse sixty-eight and rising," he said presently. "Under the circumstances, a miracle."

"Am I instrumented, or are you just omniscient?"

"Omniscient. Actually you watch the wrist and count the pulse. Easier than counting money." Seeing no response, he added, "Or was that unfair?"

"I'm sorry, I wasn't listening," Dish mumbled.

"My humor is never very successful. And I don't feel very funny, I



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feel—shocked. Lamar's loss is a shocker in surprising ways. I'm glad you weren't with him."

Dish glanced up sharply. "Why would I be?"

"You don't even know what I'm talking about," Matson said as if to himself. "By Christ, I believe it." He peered around at the other late breakfasters. "Do you play chess?"

Dish, amazed at this non sequitur, signified *no.*

"Table tennis?"

Dish, with a quizzical look, "Used to be fair. Why?"

"Unless that cut bothers you I suggest—no, I prescribe a game to loosen up."

Her face said Matson was a fool. "*Now?*"

Matson played it for her. "Well, not here in the dining room no. In the lounge."

In the same irked, bantering tone she said, "Give me one good reason."

"Here's three: it develops hand-eye coordination, it keeps you trim, and," his voice dropped, "the table tennis room is soundproof."

Dish saw that Matson was deadly serious, his corneas like black ball bearings under the straight brows. She signed her chit, pushed away, and strode out silently. In the hall she turned toward the table tennis room, Matson following with his aging athlete's gait.

"Ping for serve," Matson said, grabbing a paddle. "It isn't completely secure in here." He drove an honest, efficient serve. "Been talking with . . . people in K.C . . . about Warren's accident," he said, returning a wild forehand from Dish. "And I'm worried . . . about some details. Was he into drugs? Or gambling . . . though gambling didn't . . . seem his bag."

"He didn't even have . . . the penny bag," Dish chided. "Not even pot . . . but he drank a little. Warren didn't gamble . . . *period.*" She punctuated it with a slam and made it.

"But cannabis in his ashtray," Matson persisted, "and alcohol . . . in his blood . . . his system."

Dish began a furious volley. "Planted. Had to be. He'd tried pot . . . and hated it," she grunted. "None of this . . . fits Warren," she went on, unconsciously using the present tense. Realizing it, she missed an easy shot. "Damn you. Come on . . . out with it."

"Just between us . . . Lamar raided his account . . . several times . . . in the last . . . two weeks. Always put in . . . lots more than he . . . took out. Borrowed from the . . . credit union . . . at first." Matson missed another of Dish's supersonic forehands and retrieved the ball. For a moment he watched her, motionless. "He started with eight thousand and parlayed it to a hundred thirty thousand, then asked his banker about Swiss accounts. Late yesterday he took it all out." He shook his head and served. "Miriam, that is big money. How?"



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"Aren't there laws . . . against prying . . . into private accounts?"

"Laws and laws . . . against misuse of funds . . . and bankers I . . . play handball with," Matson puffed. "Lamar had . . . a free hand with . . . research funds. You both did. It wasn't . . . a pretty picture." He watched her futile slam sail away. "Lamar may have been running for the jetport."

"And you think *I've* been into the grant money? Chuck Matson, I can't even afford a tri-D! My account will show that—only I won't permit it."

"I already know, your account was at the same bank since when you and Lamar—well, anyway," he finished lamely.

Dish gnawed her lip. "Who else knows about Warren and me?"

"Only everybody with a milligram of romance in his veins. Did you think it was a secret?"

"I thought it wasn't anybody's bleeding business! Can't you people stay busy in your own affairs?" The game forgotten now, both of them spoke with soft intensity.

"This *is* my business, and Lamar wasn't too busy to squeeze God knows how much, maybe over two hundred thousand dollars, out of someplace. But was it *here*?" He struck the table with his paddle edge and Dish saw the muscles cording in his neck.

"I don't know. But you sound like Warren isn't—wasn't the gambler, but the house."

"Exactly. He was onto an absolutely PVC pipe cinch, a nongamble gamble. He wasn't a gambler. Not like you are."

"Me? What did I ever bet on?"

Matson almost smiled. "Your forehand smash, and Warren Lamar. And with him I don't know if you lost, and I don't want you to tell me."

Dish laid her paddle down very carefully instead of throwing it at him. "All you want me to do is assassinate his character, posthumously."

As Dish headed for the door, Matson moved to intercept her. "Assassination? Men have done it for less, Dish! And Lamar is dead. Christ, now you're in charge of the funds yourself! Is there a big hole in the money? And how fast can you find out?"

Dish stopped, her eyes distant. "I hadn't thought of that; there are the kids to think of. You aren't worried for your precious administrative bod, of course."

It did not pass him. "If you believe that, you'd believe anything. But think, Dish: where or how did Lamar get a pipeline to the money tree in fifteen days or so? Not gambling, nobody guesses that well without knowing the unknowable."

"A hookup to tomorrow?" With her quote from Lamar, Dish felt the sunburst tingle of sudden knowledge. MERRY MOHR! She clasped her temples, a dozen possibilities fighting for focus. In seconds, one chain of reasoning hammered itself home. *If*



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*Merry is prescient. Lamar could've guessed.* Another piece of the puzzle dropped into place: *If Lamar could profit from it, he could ruthlessly keep it hidden.* She looked up at a worried Matson. "That's why he erased the tapes," she said aloud. "He guessed about Merry before I did."

"Talk sense, Dish."

"I can't. Just wait a minute." He saw the gleam of purpose return as she said, "How could Warren profit if he could see thirty-seven minutes into the future? Don't tell me it's impossible; answer my question!"

Matson gaped, then leaned against the game table. "State lottery? Nope, only once a month anyhow. Sports, maybe. Stocks? Hm, but they aren't all that volatile."

"Volatile?"

"Economist's term," he waved a hand vaguely, then jerked his head up. "Like commodities. I guess it's possible. But . . ."

"Shut up. Have you ever heard of a government cop named Neil Fox, or *any* cop, dropping into a research lab without going through normal administrative channels?"

Now Matson did smile. "Almost unheard-of. Since the seventies they're very, very proper. Who's this gent, Neil Fox?"

Dish threw open the door, nearly decapitating Matson. "Not our agent, and not a gent," she snarled. "And he's after one of my kids! Come on," she called, sprinting down the hall.

Matson was winded from running and furious with confusion when they arrived at the empty playground. From Dish's few words en route he realized they were searching for Merry Mohr and, seeing Dish dart into one room, he opted for another. In moments they knew that Merry was not with the other children.

Bill Fletcher followed Matson into the hall. "Doc, don't worry about Merry, I know where she is." Dish heaved a huge breath of relief, then heard young Fletcher say, "The big visiting fireman—uh, Mr. Fox?—asked me to let him observe her in the lab."

Fletcher stared in disbelief as Matson charged off toward the lab, Dish just behind. The youth followed.

The lab was empty.

"When did you last see them?"

Fletcher blanched. "Ten, fifteen minutes ago. Jeez, what'd I do wrong?"

"Nothing," Dish snapped, fighting for breath and courage. "Bill, get the provost on the line."

"Hold it," Matson grated. "Dish Deshong, you are directed *now* to tell me what's happened. I can help you or stop you. And you don't look all that stable."

Dish began her reply with a slap that rattled Matson's marbles. "That's for suggesting I'm hysterical when I'm goddamn mad." Her voice was rhythmic, steady, between hard breathing. "Merry Mohr has been kidnapped, as you can clearly see, by



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a man posing as a government agent. I'm sure he had Warren fooled; Warren didn't toady like that to mere mortals."

Matson rubbed his jaw, then with sudden alertness, said "Son, did Mr. Fox have authorization of any kind to take the Mohr girl from the lab?"

Fletcher glanced around from the vidiphone. "No, *sir*."

"Then we move." Matson went to the phone. His exchange with the provost was briefly thorough: contact all campus security, stop anyone at shuttle or taxiport without campus ID, especially if he had a small blonde girl in tow, and search every outgoing private vehicle for the girl, relay any questionable ID to Matson at the Speech Pathology lab. Matson did not explain when the provost, an old friend, asked why he was speaking oddly.

"Speaking oddly," he grumped. "I'm lucky to be coherent after that haymaker, Dish. Now *you* be coherent. Why is this man after an autistic child?"

Dish took a deep breath. "I should make up a plausible lie. You won't believe it."

"You'll have to try me."

After sending Fletcher out, she told him.

'You're mighty right," Matson laughed. "I don't believe it—but maybe your Mr. Fox does. Great God, you don't suppose he *is* a government agent?"

"Whatever he is, he's gonna be a sick one when I see him. If you wonder why Fox is convinced Merry has this deviance, ask yourself how else Warren could get rich so fast on the stock market."

"Hm, you have me wavering," Matson half-smiled. "But how could he ask questions of a tiny girl who can't even talk?"

"I don't think he did, exactly." She raised her voice to Fletcher, who was instantly back in the room. "Bill, did Mr. Lamar have any unusual interactions with Merry lately?"

"How?" Bill fetched a broad shrug. "Merry wouldn't let him near her recently in her normal response patterns. Some of those weird prelim routines of his may've hurt her. He had me give her the mild stimulus routines the past few weeks."

Dish bored in. "Not normal stuff, Bill? What, then?"

"Nothing painful, just mild electrical stuff; you know, twitch responses on her arms and legs. She didn't like the straps one bit. This bastard Fox may have a double handful, 'scuse me, Miz Deshong."

"This bastard Fox may *be* a double handful if he can use Merry," Dish said with a hard look at Matson. "But Warren used a whole lab to feed stimuli to Merry. Knowing Warren and the principle of parsimony, if he used it all, he needed it all. Including an assistant."

Bill Fletcher was near weeping. "I used to take a schedule every morning from Mr. Lamar," he said, "and zap that poor little kid starting



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at nine-thirty on the nose. Thirty-second intervals for about ten minutes. You mean it wasn't to help Merry?"

"It may yet," Dish soothed, "if I can convince Dr. Matson that Merry is worth stealing. When does the market open?"

"Ten in New York; that's nine, here," Matson said.

Dish studied her sandals blindly for long seconds, then murmured an affirmative, "Uh-huh. He was feeding stimuli to Merry thirty-seven minutes *after* seeing her responses."

Matson squinted. "You've lost me."

"Okay, imagine Warren with a list of, uh, twenty commodities at, ah, eight fifty-three, watching Merry through an isolation window. She glances at her arm—say, the left one. That's his signal that Commodity A goes up significantly during the first half-hour of trading. Thirty seconds later, from what Bill says, Merry might look at her right arm. That's Warren's signal that Commodity B goes down during that period. And so on for twenty items, one every thirty seconds."

"But Lamar wouldn't know what stimuli to program until later!"

Dish fed him a pitying look. "Of course not. I know for a fact that Warren kept himself cloistered away next to an isolation window with a vidiphone every morning recently from before nine until nearly nine-thirty. He was keeping the channel open to some broker. See, by nine-oh-three he'd have Merry's responses completed and would plunk down bundles on those commodities, and only those, for which Merry glanced at that left arm. And he could tell the broker to sell the whole batch of purchases at nine-thirty." She glanced quickly at Matson: "Or can you sell a commodity instantly?"

"You can these days," Matson admitted.

"Then it'd work," Dish insisted. "What's crucial is that Warren had to make his unalterable decision, *before he began to watch Merry*, that he would program the arm and leg stimuli depending on what the broker told him about the trading flurries by—oh, just about nine twenty-five. You understand, I don't say Warren did it exactly this way in every detail, but I know that he *could* have."

"Slow down. You say Warren told the broker to make very short-term buys at around nine-oh-five. What did he do then?"

"He stayed on the horn and ordered the broker to give him a simple yes-or-no checklist of those unalterably chosen twenty commodities by, maybe, nine twenty-five or so. Do any of 'em really jump?"

"Sometimes—and both ways. I think the market's honest, but it can fade you like a Cheshire cat."

"Well, those items that rose quickly and early got a quick 'left-arm' checkmark on the stimulus chart so Bill, at exactly nine-thirty, would start feeding arm-twitches to Merry



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in the predetermined order."

"So Lamar could get twenty answers in a minute or two from the broker, translate 'em into stimuli marks, hand the schedule to Bill a minute later, and—then what?"

"Then go count his loot," Dish shrugged. "He'd be done. You see, he'd already got the responses to those twitches thirty-seven minutes before they were made."

Matson, studying her, scratched an ear reflectively. "Let's say I'm Lamar, and I see left-arm glances for items A, D, and G. At that point I already know what items to buy. What if I just made my buys and didn't program any stim—oh," he finished.

"Oh indeed. It all hinges on the sure decision, before starting, that you *will* run the schedule when the time comes. Is Merry's delay exact to the second? I doubt it, or Warren could've run the stimuli quicker."

"Wouldn't the muscle twitches come early, too?"

"You're a doctor: think! Muscular responses are synaptically local; it's only her cognitive responses that lag. And she'd probably keep glancing at her parts as long as she felt funny business. When you're autistic, you don't get bored easily."

"Why did he have to ask the broker for the list? Why not just program those stimuli he knew, from Merry, were the right ones?"

Dish sighed. "Because in the communication system Merry is only a link. The broker is the source. Part of that unalterable bit is that you do what the broker says."

"Seems to me," Matson said, "that broker'd be sniffing the air hard and maybe talking about it after this happened a few times, ethics or no ethics."

"Could be. I have a satchel-mouth for a banker," Dish said darkly.

Matson injected, "I wonder if this could be done on a two-step basis? Multistep? I mean, use his nine twenty-five data based on what Merry might know thirty-seven minutes after *that*! God, it gets complex. Bill, did Lamar observe Merry later in the day or run more stimuli on her?"

"No, only once a day," Fletcher replied. "I was the only work-study he used for this. The stuff with Merry was Greek to me but *this*, boy,—this is Linear B!"

"It's just as well. Chuck, Fox probably can't make use of Merry while he's ducking campus security and carrying a little bundle of barbed wire. But why did Warren ever bring Fox into it?"

"Maybe Warren's sudden success brought Fox into it. We don't know whom this man Fox works for."

"I got a tougher question," Fletcher said. "What if Fox gets off-campus with Merry?"

Matson and Dish exchanged lost looks. "He might get rich," Matson said. "Or his government might get a slight jump on the space-time continuum. And that, Dish, is what worries me. If Fox is any govern-



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ment's cop, he gets Merry or nobody does."

"How do you know that?"

"I don't; but I can guess what he'll try. Either he gets her, *or*. He knows what other governments would do. Horseshit; *will* do, if they believe in this nightmare deviance!"

"Why should they? You don't."

"You ask too much. I'm on the fence, and that's something."

"And here we sit *waiting*," Dish moaned. "Can't we alert the state police?"

"Done. My neck's out a mile but I'll accept kidnapping by this lunatic Fox. We're waiting for security to do its job, he can't leave the campus on the ground or over it. What else is there?"

"Omigod, the sling tubes," Fletcher breathed.

Matson slapped his forehead with the heel of his hand. "Underground! Damn, I'd forgotten."

Dish watched Matson stab a vidiphone code. "But that's only cargo pods, isn't it? I thought the system was on the fritz."

She learned differently as Matson quizzed Phil Royce of the university's physical plant staff. Conceived as a rapid-transit system, the sling tubes were favored toys of the engineering school. The cylindrical pods accelerated magnetically along the maze of tunnels and required partial vacuum for efficient operation. Much of the time its safety interlocks denied a transit, thanks to seasonal changes in the broken plains and their effects on the too-shallow tunnels. And at best the power requirements were high. Tunnels ran to several campus buildings requiring massive supplies and to parallel tunnels arrowing off to the Kansas City Quay area. This week, Royce admitted, it was working. And this week its programming staff were all at a Chicago seminar.

"Open all comm circuits to the pod terminals," Matson snapped into the vidiphone, "and try to spot a big man with a small girl. And dig out the system prints, we'll be there in a minute." On the way out he shouted for Fletcher to relay calls to the physical plant. He dashed for the parking lot, Dish running after. She stole a glance at her wristwatch. It was past noon. Merry Mohr might already be dead.

Matson, with a master access code to all university vehicles, dived into the first runabout he saw, Dish claiming the second seat. They slid to a halt minutes later outside the central control of the campus physical plant.

Phil Royce was waiting inside with blueprint tapes on his main console display. "If you intend to use the tubes now," Royce began, "forget it. System's down until one forty-five and there's no damn thing we can do about it."

Matson barked, "Why not?"

"Power requirements. This place pulls too many amps around noon, so there's a basic downtime programmed into the whole sling tube



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system until one-fifteen. Then it takes another thirty minutes to pull the necessary vac on the tunnels again. Don't tell me it's a helluva way to run a railroad. I know." Royce frowned.

"It's lovely," Dish beamed. "It means Fox can't have left here."

Matson was scanning the display, muttering to himself. Then, "How much slop in the timing?"

Royce shrugged. "None. Vac is usually up a few minutes early but the system is stupid. No sling power until one forty-five."

"If there were some way to monitor all the campus terminals," Matson began.

Royce said, "If it's only the on-campus terminals I can help. Like so," he added, turning to the display control.

Under Phil Royce's sure fingers the display wiped away the system diagrams. A mosaic began to appear, each a picture of a loading dock somewhere on campus. At a few locations, workers were exploring lunch bags. The gaping clamshells of sling tube pods could be seen in some of the pictures; several rectangles were blank. "Always got a few dead videos around here," Royce grumbled. "When're we gonna get remote focus rigs, Dr. Matson?"

Matson ignored the question, staring hard at the display. Dish had never studied a cargo pod closely. It seemed to have a fold-down seat near the front, but in the murk of the pod she could see little detail. If it were dark in the pods, Merry Mohr would raise total hell because she hated the dark like . . . then Dish flashed one of her sudden suppositions. "Mr. Royce, are there lights in the pods?"

"Supposed to be, but the engineering boys are a long way from using the system on a regular basis. Nope, no lights, spooky as hell riding one. Every little erg of power . . ."

"Good. Merry's records show that when she first began her autism she was two years old—and she already had a deathly fear of the dark! Fox may just have bedlam in close quarters."

"Lotta good that'll do," Matson spat. "He'll already be halfway to K.C." Then he saw Dish's face alight, her vigorous headshake contradicting him. He stared at her an instant, then grimaced, "Oh Dish, Dish, can we seriously believe that little girl will throw a fit a half-hour before then?" He glanced at Royce as if for help. Royce understood nothing of this exchange, and it showed.

"One of Merry's strongest aversive stimuli before her illness was the dark. If she hasn't been responding it's because we didn't know when to watch!" She closed her eyes briefly. "Ah, thirty-seven minutes back from one forty-five: one-oh-eight. If they're holed up near a terminal that's when Merry will tell the world about it."

"*If* Fox is near a terminal," Matson stressed. "Well, it's twelve forty-seven. Phil, think: how can you



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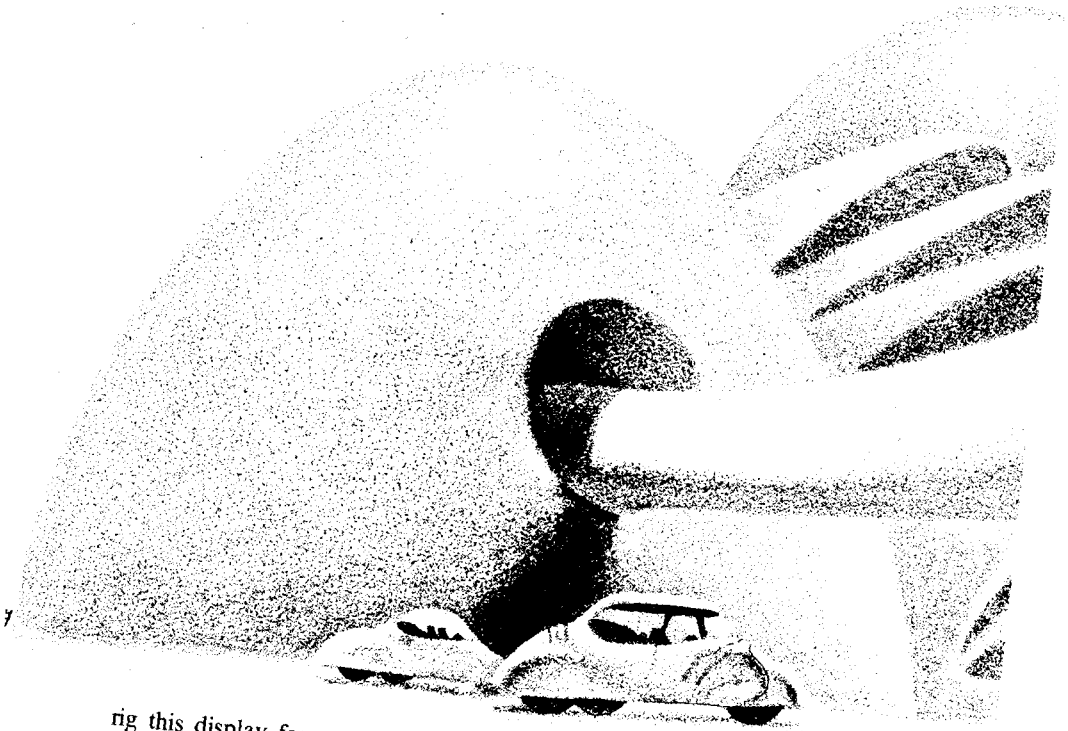

rig this display for maximum audio and video information to search the terminals?"

Royce frowned over his console, fingers roaming gently. After some false starts he sat back. "On the left, display of the master print again. To its right, small displays of every campus terminal. Forty-four of 'em, five videos down but all audios are up. Numbers on the print match the indices I punched into the videos. When you see something, find its location on the master print."

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"Are all audios live simultaneously?"

"Right. Seven columns of push-buttons here, seven terminals to a column except for the last column, with two. If you hear something special, start cutting columns out. When the noise goes out you've narrowed it to that group of seven terminals. Then cut in that column again and start cutting, one by one. It's pretty quick, really."

Matson passed a hand over his eyes. "Phil, I know you're working

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with patches on patches with old equipment, but it seems pretty risky to depend on it. You know we're hoping to find a six-year-old girl yelling bloody murder shortly after one P.M. Dish, go to the runabout and point it toward the main campus. Master access code is oh-oh-six-oh-one. Keep the doors open. Saves seconds."

Dish obeyed. Matson was on the vidiphone again as she exited. She didn't trust Matson; he was as likely to order her stuffed into a straitjacket as to check on Fox.

Dish parked the runabout on a lawn downslope near the steps, nervously checking fuel-cell readouts and, every thirty seconds, her watch. At one fifteen she could take inactivity no longer and scrambled from the runabout. In the distance, two campus security men stalked the hedgerow on the campus perimeter. Both held the rarely seen telescoping billies, proof that Kemper, the security chief, was taking it all seriously.

As she entered Royce's office she saw the school president, Karl Frye, framed by Matson's vidiphone. Matson saw Dish but did not pause in his discussion. "But there's reason to think the pair is still on campus, Karl. Are you absolutely sure we can't . . ."

"Positive," Frye said firmly. "It's not within my power, Chuck, and perhaps not even very smart. Picture gangs of student vigilantes converging on the sling tube terminals, and someone mistaking an aide for your suspect. Now ask yourself something: are you sure you aren't overreacting?"

Matson drew a long breath, then said, "Not entirely." His flickered glance at Dish was eloquent—*look what you made me do.* "All right, Karl; thanks for the support, I'll get back to you."

Frye's laconic, "In an old vernacular, you better believe it . . ." was flicked off as Matson stood. For a moment he and Dish stared each other down, then Dish quickly checked her watch. Only ninety seconds since she left the runabout? Impossible.

"Sorry about the one-oh-eight deadline," Matson said quietly.

Phil Royce, at his console, shamed them with his calm. "Just thought of something. I could patch in a voiceprint match, if you have an audio record of the little tyke or the guy. I didn't take an MA in tech comm for nothing. That'll let us pinpoint the terminal quicker, too."

Dish brightened, raked her memories, then nearly sobbed. "Not a thing on either of them. I could *kill* Warren Lamar!" She stopped then, the cold irony of the phrase careening through her mind.

She was near a breaking point and, she knew, Matson could see it. "It may work yet, Dish," he said, and touched her arm gently. "How's that scrape on your back; giving you fits?" It was a free excuse for tortured nerves and Dish managed a smile.



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But, "You know that's not it," she husked. "Look, some of us are built for stress situations and some of us, well . . ."

"Don't lecture me on your function. I have eyes," Matson grinned.

Dish was only half-irked. "And a wife, and a weird sense of humor at a time like this," she sighed.

"Dr. Matson, Ms. Deshong, we're getting something!" Phil Royce rode the audio to full gain, a welter of noise cascading from the speakers. As he flicked columns of buttons, they heard the step-by-step shift in the audio mix. Dish wondered whether she heard, or only wanted to hear, a faint nasal howl. Royce cursed and reopened all columns of input. "Nope. Thought I heard a kid yelling but—damnation, what am I thinking of." His long strong fingers played over the console as he spoke. "We can see most of the videos anyhow, we only need audios on those where there are pods ready and no staff working . . ."

Royce froze over the console. A thin wavering cry ululated inhumanly, like a muezzin in hell—from which terminal? "I've lost it. I screwed it up," Royce crooned, his hands an ambidextrous blur.

"Merry," Dish breathed. "That's Merry Mohr."

"Say again, say again," Royce begged softly, concentrating on two columns. The quality of the sound mix shifted again and they caught two more salient outputs: a soft male curse, then a muffling of the rage in Merry Mohr. A moment later they had lost it.

Matson straightened, arms akimbo. "Okay, what are the locations?"

Royce gestured at the print layout. "Ad building annex. Stadium. Fine arts center. Book depository. Repair dock. Two others but there are repair crews around 'em."

"Great, sites all over the effing campus," said Matson.

"Wait!" The men turned to Dish who stood wide-eyed, staring as if blind. "Of all those places there's only one with that kind of echo."

"What echo?" From Royce.

"Where?" From Matson in the same instant.

"In the prop room of the fine arts auditorium," Dish shot back, already heading for the runabout.

"That's where the terminal is," Royce called to the two retreating figures. "I'll pass the word." He would have added that the video there was up, and showed nothing, but no one was left to listen. The time was one twenty.

Matson flung himself into the driver's seat while Dish, in culottes, was only fractionally slower. As the runabout ghosted over the greensward, Dish said, " Speech pathology gives you a tuned ear, Chuck. There's a flattish metallic little echo down below the big stage in the Fine Arts Center. I was over there last week; they're working up a production of *Medea*. Anyway, I could hear it counterpointing Merry."



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Matson, reaching for the dashboard commset, said, "You seem awfully pleased."

"Merry's alive—and kicking, I hope."

Matson contacted Royce by his only available channel, the radio. Though fully automated trip programs were built into the runabout, the innovation was only three years old. The legal prohibition of front seat video had not yet been changed in midAmerica and, though private vehicles flaunted the law, state vehicles did not.

"Video and audio are both working there," Royce reported, "but I'm not getting any action."

"Phil, I need you as a go-between. Call security and ask for a chopper to the Fine Arts Center. We're ten minutes from it with no weapons; someone may be closer or better equipped." He veered onto the twin ribbons of an access road, beeping the two-tone urgency note at a bicyclist just ahead. For a man who didn't really believe in any of this, Dish reflected, Chuck Matson was cutting a lot of corners.

To a suggestion by Royce, Matson was firm. "Don't say *any*thing on your audio to let Fox suspect we've pegged him. Not unless you actually see him entering the pod. And don't punch off, Phil, keep me posted."

They crawled at an exasperating forty miles an hour, listening to Royce's office sounds. Presently Royce coughed. It had apology in it. "Uh, Dr. Matson, security's on the horn here. He'd like you to contact him."

Matson stared hard at the road ahead. "Is it Vic Kemper?"

"You can say that again."

"Does he have anybody who can beat us to the center?"

"Neg," Royce replied, "but he's pretty insistent—even heated, you might say."

"He can't help yet, but we're doing his thing, right?"

"That, and the likelihood that you're walking in on an A-and-D."

"Say again?"

"Armed and dangerous. He got me with that'un too," Royce chuckled.

A marginal pause. "I'm not receiving too well, Phil. Fact is, I'm having a rough time with words."

"Not happy with the ones you hear?"

"*Plus ca change, plus c'est la meme merde.*"

"Say again?"

"See, you're not getting me either. Tell Kemper that. And urge him to get his martial ass in gear with all possible speed." With that, Matson punched off. He ignored further lights from the commset.

The clump of gleaming mushrooms that was the Fine Arts Center grew by proximity to become a complex of sprayed ferroconcrete buildings. The wall of a sling tube emerged from swooping green contours to penetrate the lower auditorium structure. They whirred into the parking area in the shadow of the



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complex. The lone vehicle they saw seemed huddled to itself in the vastness. Matson stopped nearby, glanced inside the small sedan while hurrying past it, then stopped short.

"What's wrong?" Dish was impatient as Matson dropped to his knees, peering under the sedan.

In answer, Matson flopped on his back and reached beneath the car's rear. In a moment he was up again, wiping fluid from his hand as a puddle appeared beneath the electric car. Matson rejoined Dish with, "Very cute. There's a rotary engine in that thing with whopping mufflers. What we used to call a Q-ship, a racer in overalls. Also very illegal. Also," a tight grin, "should seize up in minutes with all his coolant drained. I wonder if Lamar supplied him with it—and with his information on the sling tubes."

Dish nodded. Matson asked cautious questions—good. And in physical confrontation he'd give away too many years and forty pounds to the desperate Fox—not good. They were both panting as they reached the ramp to the prop room area, and Dish pulled Matson to a halt.

"Breathing time," she begged, "and thinking time too. We can't just barge in and say 'hands up'."

"Hell we can't. Our function is to delay Fox 'til Kemper shows. You have a better idea?"

"Yes. Let me go ahead."

"Out of the question—and if you slap me again I'll flatten you."

Dish pressed on quickly, "Our chance of sneaking up on him in this place is roughly zilch. But he knows me. If I can flush him with you out of sight, then maybe you *can* flank him. He's a very big, ballsy guy, Chuck, and I could make him overconfident. Must I give you a goddamn syllabus?"

Matson's wry smile was admiring. "My marriage is legally open. I haven't seen Therese in weeks," he answered.

"Why tell me *now*?"

"It's now I think you are some kinda lady, Dish." He jerked a thumb at the door. "I'll give you twenty seconds lead. Use it before I lose my resolve."

Dish's watch, as she started down the hall, read one thirty-eight. Her first impulse was toward the loading dock with the fateful sling tube and its silent open pod. Then she recalled the narrow spiral staircase that began near the loading dock and emerged on the huge stage above for special effects. It would be unnatural to tiptoe. Dish strode through the cavernous prop room, noting that the lights were on. Simultaneously with the echo of her footsteps came a faint whooshing rustle, then silence. It could have been a stage curtain—or a soundproof door.

The main stage was directly above, but the center boasted a small practice theater complete with its own proscenium and flies. It adjoined the prop room. Dish swallowed her heart, walked to the door of the little theater, and slid it open.



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She was met by full incandescent lighting. Squarely in the center of the miniscule stage sat Merry Mohr, toying silently with dacron cables tied to her wrists and ankles. The soft slender ropes were slack but ran through a metal ring and ended with half-hitches linking Merry to the throne which dominated the upstage portion of the stage. Dish felt liquid nitrogen in her veins, staring at the big man who lounged on the prop throne. Neil Fox smiled easily at Dish, obviously enjoying the moment.

Dish made herself a foolish stereotype. "Mr. Fox, my goodness! What on earth? And isn't that one of our special children?"

Fox uncoiled—he seemed to like doing that—and as he arose, gripped a support of one throne arm. The support snapped. Fox stepped between Dish and Merry. "The person I least expected. How symbolic it all is," he purred, relaxed and easy. "You people even call them 'special', without knowing how special. In another quarter, children like this will be *sp'itsiyalniy*. The same word, really, but with somewhat different research orientation." Again that damnable warm smile.

"Is that a Russian word?" Was she talking loudly enough? Could she divert the feral Fox from the doorway? She looked her question at Fox and moved around him as if to see Merry better.

"I believe it is," he said. "Though not presently Soviet research." He glanced at his own watch. "Our charade is pleasant; Lamar named you well. But in a moment I must take my small charge and go, Dish Deshong." An earnestness crept into his tone. "We value this little person very much. If *you* do, you won't force me to hurt her. Or you."

"I valued Warren Lamar, too. And it seems to me you force very easily."

"I have only limited regret for Lamar. He was a selfish one—and a superb guesser." His eyes widened slightly as Dish stepped nearer.

"I'm right about the girl, then? She does have a feedforward loop." Dish held his gaze, forcing her eyes to ignore the flicker of movement at the doorway.

Neil Fox answered vaguely. "Perhaps unique at this time. You can't possibly appreciate the expense of taking her with me. If it's any comfort, I was ridiculously unprepared to act so soon. And," his voice suddenly chilling, "you are much too close." He waved her back, a single slashing chop suggestive of military arts.

With smoothness that seemed choreographed Fox stepped away, dipped to pull the knot of Merry's bonds from their mooring, and hauled Merry aloft, while watching Dish closely. Uncomplaining, the tiny girl hung across the massive shoulders, a trophy of the hunt. Perhaps it was the very lack of volition by Merry, or the sight of the silken silver-blonde hair tumbling to



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hide the little face. Dish cried out and leaped at Fox.

The impact was too sudden to hurt; the heel of his free hand jarred her chin precisely enough to stun, not enough to fracture. Dish, rising to hands and knees, saw through her own jumble of hair as Fox bounded to a squat table, where the play's props rested. A rhinestoned cape, a trick goblet for the sorceress Medea, other small objects swept to the floor as Fox deftly snatched the crucial item, Medea's dagger.

"Oh God, don't!" Dish's scream froze a tableau. Fox, his small bundle now held as if weightless against the formidable chest, held the dagger point gleaming an inch from Merry's viscera. Matson, teeth bared, held both hands before him as if imploring, only steps away from Fox who now saw Matson, and respected what he saw. In one of those imploring hands Matson held a trimming hatchet from the prop room, rusty with disuse. Very slowly, Matson lowered his hands, his eyes forged to the blade of Fox's weapon.

"You primitives," said Fox in soft contempt. He flicked an impossibly quick glance at his wristwatch, the knife blade glistening in the light at his motion, then pulled Merry close. The big man backed past the doorway, Merry held high on his chest, Matson following helplessly with Dish in tow.

"Three things," Matson croaked, proceeding more strongly, "we've blocked the sling tube up ahead, every exit is manned anyhow, and some very rough types are about due here." Finding no response he added, "You want murder one on top of kidnapping?"

Fox moved near the open pod. They could all see the emerald READY FOR USE legend shining in its surface. "My briefing says you lie," Fox said almost to himself.

"Try it and see."

"My notion exactly."

As Fox shifted his burden, Merry began to whimper and Dish made her decision. No time to explain or threaten: she reached the littered workbench in three steps and grasped a hefty injector for instant-set foam, lying between matched scenery molds. Now Merry was fully active as only a wild child can be. Dish kept the tiny fingernails closely trimmed but at least one caught Fox across an eye. The craggy head snapped back, trying to keep Matson and Dish in view while a spitting ball of pure energy shrieked and raked his face. At that instant, a monstrous voice resounded through the area.

"FREEZE RIGHT THERE!"

For Dish there was no mistaking the booming volume of the loudspeaker; she knew it was Phil Royce speaking from miles away. Fox whirled completely around, searching wildly, as Dish used the distraction to bound near him. Matson began a clubbing swing with the hatchet but Fox, sidestepping, avoided it. Then Dish triggered the



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foam cartridge around the big man's feet, then up to his knees. The stuff air-polymerized with phenomenal speed and enough exotherm to blister. Viscous brown slurry puffed on Fox's legs and his footing was suddenly uneven. Fox crashed to one knee.

"Blame yourselves," Fox howled, and plunged the dagger against the little girl's unprotected body, and again, and still again.

Matson, fearful that a wild blow might strike Merry, was waiting for a less hazardous moment. He shouted as the knife struck Merry and caught the little girl as Fox dropped his dacron cable. Not for an instant had Merry ceased her tantrum, nor did she stop when Matson scooped her up, his hatchet falling forgotten to the floor.

"Dish, foam the pod, the goddam *pod*," he called, sprinting to a jumble of stage furniture. Any one such blow could be fatal to an adult, let alone a child. Matson snap-judged that her chances were roughly nil. He placed Merry on a musty divan and wheeled to aid Dish, who might live or die depending on his next moves.

He saw Fox, tumbling into the pod, hurl the dagger straight into Dish's midriff. Dish staggered, whooped an insane laugh, and aimed the foam cartridge into the pod. The dagger skittered across the floor and Matson dived for it as Fox, who had found the dagger ineffectual against the growing mass on his body, struggled to take something from his coat. Matson saw that Fox might still escape if he had a projectile weapon.

Fox's weapon was strange to Dish but she knew it must be that. Foam spattered over the hand that held it, the stream of slurry beginning to wane as the cartridge emptied.

It was enough. Neil Fox, his face and upper torso caught in the same swelling mass, made a convulsive leap from the pod. A soft pop from inside his cocoon swelled it further as Fox, perhaps accidentally, triggered the weapon.

One arm was free, the other caught up in the foamed mess. Matson fell on the free arm with an arm bar hold, applying it as well as might be over the puffy mass on Fox's torso.

From inside the cocoon came horror. Long shuddering gasps, then the terrible sounds of a big animal strangling on the contents of its stomach. Matson was literally hoisted from the floor, the great hand tearing away his shirt front in its spasm. Matson rolled away cursing, incredulous, and sprang back. Fox, lethal still, flailed with the free arm at his ghastly prison, raking a trail of broken fingernails and torn foam from him.

In seconds the arm became rigid, outstretched, fingers splayed against the floor. Foam crackled as Fox's back arched. A moment later he lay still.

The extended arm, the heels, and the back of the head formed a



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shallow tripod holding the body clear off the floor. Wafting his hand above the foam, Matson sniffed at the air. He knew no substance so antipathetic to relaxation of the striped muscles but there was something in the air besides the smell of foam catalyst.

"Don't touch him," Dish began in terror, but Matson was already trying to retrieve the life he had so recently fought. He began by cutting at the foam with the dagger. Then he saw the vicious-looking blade slide up into its hilt. He watched it twice before he could take the datum in.

"Good God, Dish, this knife's a fake," he whispered, then looked quickly at the body of Merry Mohr. The body was sitting up, crooning softly, playing with the pretty fibers of the cables that bound her. Merry lived in her own subjective world, but she lived. "Ahhhhhh, crap." Matson sobbed his laugh, and began trying to remove the cocoon from Neil Fox.

Scenery foam, Matson found, was efficient stuff. It exuded an oily film to slicken its surfaces. Matson tossed chunks of foam into a corner as he worked with the hatchet, holding his breath, then scrambling away for a few fast breaths before resuming.

He was much too late for Fox. As the foam peeled from the agonized face Matson saw only whites in the open eyes, and retreated unprofessionally from the rest. The foam piece he still held was faithful to violence, a perfect death mask for the imponderably potent Fox. Matson dropped it in revulsion and pity.

Dish untied Merry, who seemed content to continue playing, and Dish saw bruises on the slender arms. "Chuck, could you take a look at Merry? She may be hurt."

From long expertise, Matson gingerly inspected the small body without disturbing its play. He was astonished to find Merry so unmarked; even the suture clamps he had applied two days before were intact. He spoke rapidly. "Dish, we're stretching our luck."

"Not entirely. Fox was so cocksure he didn't even check that prop dagger. From watching tryouts I knew it was harmless but I couldn't very well say so, he could've broken Merry in pieces with those terrible hands. I had to wait for the right moment. Still, we *were* lucky. He had time to get Warren somehow, but after that I think he was improvising all the way."

Matson snorted softly. "So far we're luckier than you seem to realize. Look." He leaned toward Merry head down, continuing in almost inaudible tones. "Phil Royce is recording, sure as hell. When Kemper's people arrive I hope you'll be incoherent. Mild shock, incomplete sentences, the works. We must have time, Dish." He turned to stare at the silent Fox. "Time," he repeated to himself.

"Will Merry be okay? Did that devil hurt her?"



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Matson shook his head wearily. "Oh, the tad's just bruised a bit, any active kid can accumulate worse. He could've easily trussed her up tight and gagged her, you know. Or sedation--any number of things if he had been prepared. I don't think he meant her any harm . . ." Seeing Dish's angry silent O he stammered, " . . . except in extremis. I don't know. I'm really tired, Christ but I'm tired."

The stentorian whack of copter blades drew them outside, Dish extinguishing the lights from force of habit as they moved toward the hall. Matson carried the inert Merry and, as they emerged into the light, asked, "What's the time, Dish? Exactly."

"One fifty-six."

Matson grunted, "One damn coincidence too many," and went to meet a quietly angry Vic Kemper as Dish eased Merry into the runabout jumpseat. Royce, watching the fight from his monitor, had kept the security man in touch.

Matson took a frontal approach, stating the barest facts. Fox an apparent suicide, the area in need of ventilation to counter an unknown toxic substance, and both Dish and Merry needing treatment for shock. "The little girl is completely stunned," he added darkly.

Kemper glanced at Merry and grimaced. "Well, I'd be obliged to hold you here until the state police arrive, except . . ." He shook his touseled head sheepishly.

"Go ahead, Vic."

"Except you really *are* the doctor. And you wrote my job description."

"And I haven't made doing it any easier today?"

"A sack fulla ten-fours on that, Doc. Can we get your statement later?"

Matson swung into the runabout. "At the dispensary," he agreed, and urged the little vehicle back across the campus. He was tempted to contact Royce and thank him, but decided to wait. He had more pressing problems to consider.

The dispensary was ideal for their needs. Matson gave orders for Merry's care before ushering Dish into a secluded consultation room. He spent long minutes thinking, conjuring a potion for them both, then eased himself into a couch next to Dish. "The cola's flat, but it's thirty percent ethyl," he grinned, and sipped. "Gaaah." Dish failed at a smile and waited for him to continue.

"All right, you called the shot," he said finally.

"What convinced you—Fox?"

"Partly. And Merry setting up a howl we heard on Royce's monitor thirty-seven minutes *before* you doused the prop-room lights." He slumped further on the couch studying his glass. As if to himself, he continued, "And if I buy that, I have to admit the possibility that this Fox is mixed up in the future somehow."

Dish stared at him dumbly, her



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mouth slack, hanging open.

"Maybe he was some government's agent, somewhere, but I—well, hell, he called us primitives! The overconfidence of a bad anthropologist among *campesinos*. He spoke of taking Merry as if it would take incredible amounts of money or energy to move her—and you can vacation in New Delhi for a couple of thousand bucks."

"You think he was from another *time*?" Dish saw confirmation in his face and waved at the air. "But then he'd know everything—would be like God almighty! We couldn't've stopped him."

"But we did; which means, *maybe*, the future can be modified. Dish, I'm just hypothesizing—wagging. We have some serious decisions to make, honey. Like what we tell the police."

A pause, then a giggle. "Not that we bushwhacked a time traveler. I like my job."

"I like you in it." He reached out, palms up, and received her hands. The barest of squeezes, then mutual release. "So we avoid talking about Merry's very special deviance and play dumb. Let somebody else theorize where or when Fox came from." He chuckled slowly, relishing the idea. "Nobody's going to figure it as we do, no-o-o-*body*."

"Except the people who sent Fox," Dish said, and saw new seriousness in Matson's nod. She watched gooseflesh move across her forearm, then shrugged the shudder away.

"And whoever it is wants Merry there, or dead," Matson gloomed. "The big question is, what's our ethical choice? Maybe they need her. Do you realize you could shut down the DEWline if you had Merry Mohr for an early warning system?"

Dish stared at Matson, aghast. "You think we should've handed Merry over to that monster? 'Kiss off, Merry, you're in somebody's army now.'" An unladylike snort. "Nobody who would sacrifice a helpless child should control her. And it isn't our ethical choice, it's *mine*. Even legally, if you want to get sticky about it."

He raised a hand in conciliation. "I'm not recommending, just broaching an option."

Her shoulders squared. Dish Deshong no longer seemed so small and vulnerable. "I don't see an option. I see a duty to a little kid. Merry Mohr is lost in her own synapses and I intend to find her."

"And when you do, what will we all have lost?"

"A thirty-seven minute crystal ball. How many children would *you* sacrifice for that?" The words came crackling out.

"It isn't the money, Dish. Never for money."

"Hell, no, for science! I can see you weighing it in that big-picture brain of yours. Do we try hard to find the little lost girl in that body, or do we drag our heels just a little, see if we can use her in the name of some catchphrase: science, money,



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national security, the good of man."

"Pretty important, some of 'em," Matson insisted softly. "I admit I'm pinched between principles."

"And ignoring the most important one."

Silence.

"*She's not a volunteer.*" Dish cried. "I know; she can't be, but that only makes it clearer. I won't let Merry be sold on the block of any principle that keeps her as she is. Maybe she'll always stay like this but I am committed, with Maffei's therapy or whatever else it takes, and the next handsome weirdo who looks at her crosseyed is gonna find me—what'd Kemper say?—A and by-God D!"

Dish had never heard Matson guffaw, and was startled when he did. "You have a way with gordian knots," he said. "Not that it matters but I agree. The thing we have to do now is kill Merry, or cure her—to the media," he amended quickly.

"Ah! Publicize the idea that she's no longer useful? You're a devious administrator, Chuck Matson."

"I could promote a full-time guard for Merry from other funding, but it'd excite a lot of comment."

"Not if she's snuck out to the Maffei clinic in Omaha," Dish put in. "And you know what? A few special children have been 'cured' by concussion."

Matson cocked his brow. "Pretty rare, isn't it?"

"Right—and newsworthy. We release a fatuous item about my brilliant deductions at Merry's sudden remission. Warren Lamar going paranoid, making wild claims about prescience when Merry snapped out of it—Warren can be useful despite himself," she said, essaying a sad smile.

"And one more thing," Matson said, "for the record. We say Merry ran to you when you found Fox."

"Yeahhh, which would make him say something to imply he'd been mistaken."

"Like, 'it's the wrong child,' or something."

Dish snapped her fingers. "She isn't a sp'itsiyalniy! That was his term, Chuck, we can claim we think he was Soviet. I think they might take that bait—whoever hired Fox."

"Or whenever," Matson added.

The official records noted that fingerprints, photographs, and retinal patterns all failed to identify the man, Neil Fox, whose weapon was finally identified as of contemporary French origin. Phil Royce's videotape recorded the fight at the sling tube and did not complicate the story offered by Deshong and Matson. Nothing anachronistic, nothing very special among unsolved cases. And nothing nearly so newsworthy as the human interest story that broke from wire services in Kansas City. Announcing the miraculous cure of little Merry Mohr, it preceded the truth from Omaha by eight months. But, as Dr. C.D. Matson remarked one evening to Chief Therapist Deshong: Merry's announcements had usually been a bit premature. ■



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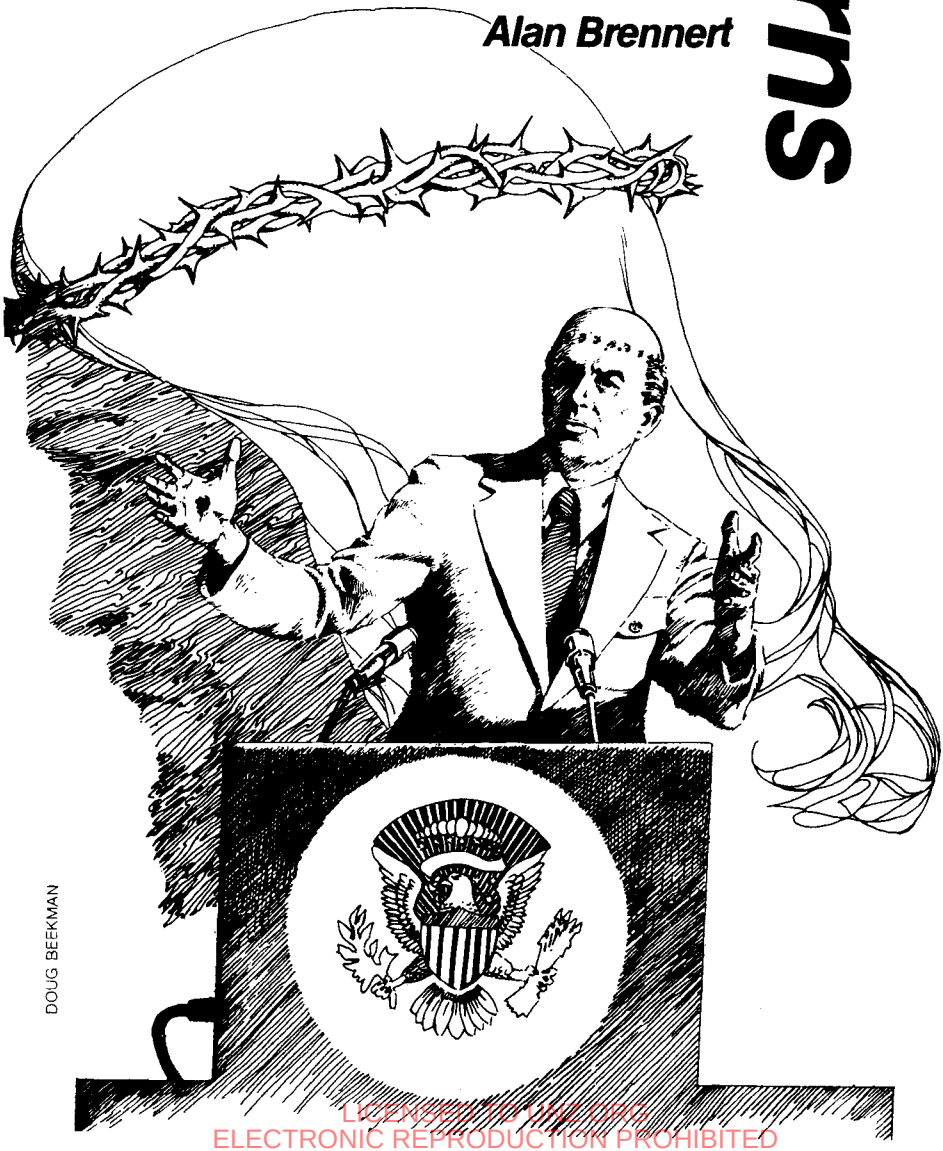
# crown of thorns

*Most humans want—need!—*
*an outside Authority to guide them.*
*The few who don't have the*
*lonely burden of responsibility*
*to shoulder.*

**Alan Brennert**



DOUG BEEKMAN

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Chosen to sit at the right hand of God, David Isaacson knew three things for certain: that it was a high and empty honor; that he would burn in a private hell if he accepted; that he could not refuse. It was quite literally the Year of Our Lord 1989, and the divine right of kings ruled in America—and could any man turn his back to God?

*April 30*

The hover shrieked up the northbound Government Lane of Interstate 5, a wet dusk falling around it. Traffic in the public lanes was light, for which Isaacson was grateful: none too good for the populace to see their governor making a fool of himself, tearing along at 90 km/hr like some half-zonked business exec flying home to suburbia. The sharp, sea-blown wind kept him awake—that and the four tabs of Alertine he had taken that morning. With luck the stim would last the next hour, and he would arrive back in the capital with no one but his personal guards knowing that he had even gone.

The meeting in Portland would soon become public knowledge, of course: the minute Cooper (he could never call him "President" Cooper, not privately, not to himself) announced Isaacson as his VP choice, the holo nets would bribe and cajole his staff for info on the rendezvous. And the staff, bless their weak little hearts, would give it. By then it wouldn't matter much.

But VP choice, for heaven's sake! What could he say to Cooper's rep? No? Like hell. You didn't say no to God, not a Christian God, not when you were Jewish—bad form. Particularly not when you were Governor of Oregon, coming up for a second term, and that idiot in the White House could squeeze off the party bosses *and* the electorate with just a word. No, Cooper had his reasons for choosing Isaacson, and they were likely to be more political than pious in nature . . .

The Alertine carried Isaacson safely back to Salem, where a gray rain made for tricky maneuvering—the aircushion slamming into unseen puddles, a sooty spray clouding the windshield. By the time he reached the Capitol building it was well past nightfall. He took a private elevator up from the parking garage to the fourth floor; he kept a two-room flat here that he often used for working weekends, feeling more at home here than in that monstrous gubernatorial residence on the other side of town. He snapped on the dim blue light in the living room; the phone rang.

He answered it, cradling the receiver between chin and shoulder while he unbuttoned his damp shirt. The dark, worried face of Robert Sanford, Isaacson's lieutenant governor, appeared on-screen. "Dave?" he said, reaching off-camera for a cigarette. "Was it Lijette?"

"The chief o' staff hisself. Offered me the vice-presidency, somewhat predictably."



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"They must want to balance the administration pretty badly. You're not going to accept, are you?"

Isaacson smiled. "Why? You don't want the governor's seat, Bob?"

"Hell, no. Well—okay, maybe just a little. But do you have any idea what the conservatives would say about an *unelected* black governor? They'd raise holy hell."

"After having me kick them around for four years," Isaacson said, "I rather think they'd welcome you with open tentacles. Don't sweat it, you'll get on fine."

Bob Sanford cocked his head to one side. "You're accepting the nomination, then?"

Isaacson slipped out of his pants, threw them onto a nearby sofa. "What else *can* I do, Bob? If I back away Cooper will have my ass in November. He's pretty desperate."

"You really think you can work with him?"

"No. But I'm going to have to try." He leaned back against the wall, suddenly tired. The Alertine was slipping away from him. "I'm really wiped, Bob. It's been a long day, a long drive, and it looks to be a bitch of a year. Call back tomorrow, okay?"

"Sure." Bob nodded and punched off. Isaacson replaced the receiver, his fingers feeling stiff and numb, and sprawled wearily on the plush sofa, anxious for sleep but dreading the morning.

He woke shortly before noon to find a White House broadcast scheduled for 1:00 P.M. Pacific time. He showered, brunched, and switched on the holo just as the Presidential seal did a slow fade-in, followed by the bland and benign gaze of President Elwood Cooper.

"My friends. . ." That same weak, tapioca-thin smile, that same whining tone. Cooper's eyes were watery but his gaze was compelling in its vacancy; it was as if the man were sharing himself with all who watched, holding no secrets to himself, fully revealed, almost vulnerable. Perhaps, after the turmoil of the seventies, that was what the country wanted; Isaacson hoped not.

"For several weeks, now," Cooper droned on, "beginning with the death of my predecessor, our nation has been in the throes of political and emotional upheaval. I have tried, in my own way, to limit that turbulence. I hope I have succeeded. Now the time has come to fill the vacancy left in this administration when I rose to the presidency, after President Malcolm's untimely death. A new vice-president is called for now . . ."

And slowly, reverently, as the gentle words were spoken, the stigmata appeared.

Cooper showed no indications of pain as the wounds appeared on his forehead: the open sores and punctured flesh that marked the thorny crown that should have been there, but was not. His wrists, limp on the desk in front of him, began to bleed—unseen nails ripped through the pale,



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freckled skin. Cooper's lids drooped, then; what he was feeling only one other man knew, and that man had died nearly two thousand years before . . .

"The man I have chosen for my vice-president," Cooper said, "and whom I pray the Congress will quickly ratify, is a man of ability and of faith . . . a man who, as Governor of his state, has instituted social reforms in the tradition of President Joseph Malcolm . . ."

Isaacson barely listened. He was thinking of the first time he had seen those marks appear on Cooper: nine months after the Democratic National Convention of 1988 had renominated incumbent Joseph Malcolm by the slimmest majority in the Party's history, almost as slim as Malcolm's victory in November. One week after Malcolm, shattered by the country's resistance to his radical social programs, had died of a massive coronary at fifty-three, leaving behind a legacy of half-finished dreams and—

Cooper. Elwood James Cooper, a party-line political hack from Minnesota chosen to *balance the ticket*, a concession to the old guard, good old coalition politics at its worst. Elwood Cooper, son of a Presbyterian minister—pious, devout, equivocal. Elwood Cooper, who one day in full view of the holo nets exhibited the same phenomenon as he did now: all the classical signs of religious stigmata.

And who, since then, had been doing all the right things, all the decent things, despite being a fool and a weakling. Both the public and Congress knew it: Someone, Something beyond the mind of their President was guiding his hand . . . and a great calm swept the nation, a peace that it had not known for decades. For now, once again, God was on its side.

"The man I have chosen as my vice-president is the honorable Governor of Oregon, David Lawrence Isaacson. I hope you will show him the same loyalty and support that you have shown me." Cooper smiled, the stigmata fading like healing blemishes. "Good afternoon, and God bless you all."

The holo tank opaqued.

*May 2*

So what's a nice Jewish boy doing in a place like this, the anteroom of the Oval Office with its deep blue carpeting and its walls so white it hurts to look at them, ready for a meeting with a man who is at best incompetent and at worst the President of the United States? Politics make stranger bed-fellows than you'd think, David. Just don't catch the clap, hm?

"The President will see you now, Governor." Donald Tanaka, Cooper's press secretary, ushered Isaacson into the office. He left quietly, leaving Isaacson face-to-face with a reserved, youthful-looking man in his early fifties, the lines of his face smooth and shallow, his expression



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peaceful and beneficent. Isaacson recalled such faces from his youth, the beatific smiles of gurus and golems, each professing to bring Ultimate Knowledge to paganistic America.

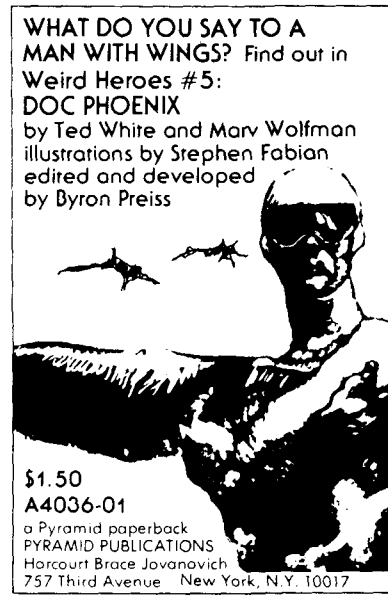
Elwood Cooper got up from behind his desk, hand outstretched. "Governor! A pleasure to meet you after our many phone conversations." They shook hands; Cooper's grip was like that of a small child, pliant and trusting. "Sit down, please, sit down. Would you like a drink? Some coffee?"

"No, no thank you." Isaacson seated himself. "I'm, ah, flattered that you would want me in your administration, Mr. President. Flattered and, if I may say so, a bit surprised."

Cooper nodded. "Yes, short notice, I agree, but the decision was made—spontaneously. As are most decisions hereabouts, you'll find. And please—call me Woody, will you . . . David?"

"Of course—uh—Woody." Yes, he *looked* like a Woody, didn't he? "Actually, sir, the suddenness of your decision is not what I found surprising. I mean, my record—my whole political style—is not exactly in keeping with the tone your administration has set for itself, in the brief time you've been in office."

Cooper steepled his fingers and looked thoughtfully at Isaacson. "I can see where you'd get that impression, David. But your, ah, 'style', as it were, is really the only difference between our two approaches to government. We're quite alike, you know."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The hell we are! "How so, sir?"

"Well, we've both enacted similar legislation, you'll admit," Cooper said, leaning forward for a glass of vegetable juice. "In your case, the social reform you've brought about has been the result of flamboyant politicking as much as sharp legal acumen. In my own case, I've tried to keep a low profile on change per se, while still effecting some modest progressive reforms."

"Um. Yes, I've noticed. After President Malcolm's five years of social upheaval, the country needs a—bit of rest?"

"Exactly. A chance to catch its



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breath without losing pace with the world."

Isaacson couldn't tell how much of this was rhetoric and how much of it Cooper actually believed. "Wouldn't a 'flamboyant' figure like me bring back too many—bad memories—for the American people?" he said, a little sharply.

"Not at all," Cooper said, sipping his V-8. "As Vice President your duties will of course be more limited than they were as a Governor—there will be less opportunity for sensationalism, I'm afraid. The office will act as a quite effective muzzle until such time as the country is ready to accept a man of your vitality once more."

Isaacson was shocked speechless. That was more or less what he had judged Cooper's motives to be in the first place, but to have the man admit it to his face . . . "You're—very frank, Mr. President," he said softly.

"Woody. Thank you; I try to be."

"If I might be equally frank—it's rather obvious that I've been selected as a high-profile token liberal. Do you also intend to flaunt the fact of my Jewishness?"

Cooper frowned thoughtfully. "Flaunt—no. Certainly we hope that to be a visible, viable factor in our favor."

Jesus! He had the Catholics, the Protestants, and the mystics, all he needed now were the Jews. "You don't find it—personally offensive?"

"What? Of course not. There are many ways to approach God; yours is different from mine and mine different from a hundred others." He studied Isaacson, a thin smile on his lips. "But perhaps I'm making hasty assumptions. *Do* you approach any God, David?"

Isaacson almost snapped, *You're the first*, but checked himself; it seemed the question deserved a serious reply. He frowned. "Sometimes," he said at length. "Sometimes, when I read or hear of people dying needlessly, starving needlessly—deaths that have no meaning and pain that has no provocation. Then I like to believe that this can't be the order of the universe . . . that someone has to be behind all this suffering, someone terribly evil, perhaps insane. It's scant comfort, Mr. President, but yes, then I guess I *do* believe in a God."

Cooper watched expressionlessly as Isaacson spoke. Finally he blinked and said coolly, "And when things do work out for the best, Governor—who do you give credit for that? Who do you hold responsible for love, and loyalty, and caring?"

Isaacson stared, unblinking. "People, damn it. Who else? The same as I hold responsible for the evil, when it comes right down to it; gods are convenient scapegoats, but you can't keep up the delusion for long." *Or at least some of us can't . . .*

Cooper nodded once, leaned back in his chair and smiled broadly. "Then you do have a faith, David.



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You're a humanist. As strong a religion as that bound to any God, wouldn't you say?"

Isaacson didn't reply. The observation, true as it was, annoyed him. He couldn't figure this man out—this blathering fool who had run with Malcolm as a sop to the party machine, now speaking sense and causing Isaacson to rethink old ethical stances. How had Cooper changed in so short a time?

"You see, David, it's all a matter of—" Reaching forward to take his juice glass, his sleeve caught on a pen clip. The cuff of his jacket slid up, exposing his left wrist—exposing the ugly gaping sore, the blood, the hint of gangrene, the wound.

Isaacson could not stop himself from staring at it: it seemed so much realer, up close, bereft of symbolism, clearly and painfully *real*—the broken veins, the punctured flesh, infected blood . . . And then a second shock: the realization that Cooper was being touched *now*, by heaven or by hell it didn't matter; he was being touched, guided, perhaps controlled by . . .

Cooper silently unhooked the cuff and replaced it, covering the wound. He looked up, his tone quietly somber. "All right, let's talk about it."

"Let's."

"You want to know if it's real; yes? I've heard the theories—all very cogent, I'll admit. Holograms. Cosmetics. Hypnosis."

"And are the theories correct?"

For a moment Cooper looked hurt and adrift, as if uncertain of how to explain a simple fact of existence. "No," he said firmly. "They've been appearing for years, never this pronounced but recognizably stigmatic. I—damn it, David, I never claimed that these signs came from God, mine or anyone else's. I may want to believe that, I may find it comforting to believe that, but I have never tried to impose my religious views on the Nation!"

"But in whatever you *do*, sir," Isaacson said cautiously, "you *do* impose those views. You work from every ethic and tenet basic to Judeo-Christian faith."

"Has any President ever done otherwise?"

Isaacson hesitated. "I suppose not. But perhaps it's time they ought. It's one thing for the average person to believe in these—these *myths* . . . but for a President to live his life by them—to live his *country's* life by them . . . ?"

Cooper sighed heavily. "There's the touch of the elitist in you, David. Maybe that's the sign of a good President. I don't know; Joseph certainly had that same touch. But to answer you—it is right and proper for a President to lead his country by those tenets when they are the only tenets he knows. The fact of my stigmata does not alter my upbringing—my 'cultural conditioning', as you would have it. And David—"

He stared at Isaacson with that honest, watery gaze, and Isaacson



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could not force himself to doubt. "It *is* real. I don't know where the signs come from, but I do know that they are not false signs, and that they are a source of both pain and hope for me. Think whatever else of me that you wish, but this you must accept—*they are real.*"

There was a tone to the man's voice, a sincerity too naked to be false; Isaacson studied him, feeling oddly off-balance, oddly convinced. He nodded slowly. "I believe you in this," he said.

Cooper leaned back and smiled gently. "That's all I ask."

Isaacson stood. "If you'll excuse me now—Woody—I still have to find an apartment. I've been staying at the Sheraton since I've been here and I—"

"Don Tanaka can help you on that; he should be able to hunt up an apartment for you somewhere near the Hill, if you like."

"Fine. Thank you."

Cooper rose and saw him to the door. "Ratification shouldn't take too long; a few weeks perhaps. I'll see you within the next couple of days, for briefings." He shook hands once more. "I look forward to working with you, David. Take care and—well, take care."

*May 4*

Donald Tanaka was a soft-spoken, amiable Hawaiian roughly the same age as Isaacson (late thirties? early forties?), formerly a reporter with the *Washington Post*, a perceptive and often witty press secretary—quite a rarity around the White House, at least. He also knew the Washington rental situation better than anyone else on Cooper's staff, and within two days had secured for Isaacson an apartment near Capitol Hill—not the most peaceful of neighborhoods since the early sixties, a jungle of stone and strife not helped much by Malcolm's urban renewal projects, but Isaacson didn't give much of a damn one way or the other.

"Won't be in here for long," Tanaka assured him as they moved Isaacson's luggage into the five-room flat. "You'll be able to move into the official vice-presidential quarters almost immediately after confirmation."

Isaacson dropped his travel case on the divan. "Soon as they finish fumigating the place?" he said in an undertone.

"What?"

"I said, I'm in no hurry."

Tanaka eyed him with interest. "Oh? Uh—why not?"

Isaacson stretched out on the couch, feeling his muscles go taut, then limp, then taut again, his body recoiling at the approach of rest, coiling, uncoiling, coiling back. "I'm furniture, Don, nothing more. Redecorate *your* White House in Jewish Modern." Tanaka laughed and Isaacson, flat on his back, pointed a finger to the ceiling in mock-sobriety. "This is no chuckling matter, sir! Surely you realize the importance of proper political carpeting? Truman



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Beige. Kennedy Blue. Eisenhower Gray." He laughed himself, then, and propped himself up on one elbow. "Christ, I'm going whamfart-bananas already. I'll be a basket case by the time I'm confirmed, you realize that?"

"No one will notice," Tanaka said lightly. "Hey, we better get moving; you're due before the Rules committee in an hour and a half."

"Oh crap. Can't I plead temporary insanity or something?"

"Nope. After you get done unpacking we'll grab a quick bite to eat and then rush over to the Hill."

"The hell with the quick bite," Isaacson said. He got up, took some stim pills from his travel case, and swallowed them dry.

Tanaka looked on with concern. "Uh, Governor . . . you might ease up on those things, if you don't mind my saying."

Isaacson flashed him an angry glance. "What if I do mind your saying?"

"Well—that's my problem, then. But you can't try to beat the pace here by loading up on Alertine twenty-four hours a day; it'll kill you."

"What the hell do you think you—"

"I'm reminded," Tanaka continued, "of a candidate for the Democratic Presidential nomination in '72, who had an inordinate fondness for Ibogaine. Wound up taking a political nose dive three months into the primaries. Then there was the Republican nominee for Senator from Oklahoma in 1978—she tried to—"

"All right, dammit, all right." Isaacson put the stim bottle back into the case, irritated more at himself than at Donald: the son of a bitch was right; it was going to be tough enough being consumed by the drooling maw of Washington, without doping himself from here to hell.

Isaacson tried to take an edge off the tension. He gave an elaborate sigh. "My luck to have a poli sci major on the staff, for crissake. But thanks."

Tanaka smiled meekly. "Not quite that bad, Governor. Journalism major, History minor. I know more about the Norman conquest of

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England than I do Teapot Dome, I'm afraid."

"Great. Great. I'll incorporate that into my first official speech: we gotta get those godless Normans out of our schools. Norman Mailer, Norman Cousins, Norman Rockwell . . ."

He goose-stepped to the door; Tanaka shut it behind him and grinned. "You know something, Isaacson? You're pretty goddamned weird."

*May 24*

Weirder still was the long run of interviews and interrogations that Isaacson ran like a gauntlet for the next several weeks. Questions about his campaign financing, about his Oregon staff, about his friends, enemies, contributors, legislations . . . Through it all he talked, straight-and-narrow to the Senate investigators, cynical and blathering to Tanaka: "My welfare program received a majority of support in the legislature, Senator; there was no lobbying involved, not on our part." ("Hey, Don, make you a deal: you take the vice-presidency and I'll become Lord Spiritual. Should fit right in with the administrative decor. We'll ban sun-worshipping after 7 P.M. What do you say?") "No, Senator, that was *not* my intention at all . . ."

It was a relief for both Tanaka and Isaacson, this sharing of bitterness and humor; sometimes they fancied themselves the only sane people in Washington, and at other times laughed at that conceit. Whatever barriers that had existed between them were quickly surmounted, and one night Isaacson (sans security guards; he had learned years ago how to bribe his way into privacy) found himself heading uptown with Donald to see someone named Lisa Donerey.

"She's going to help us ban the sun-worshippers, right?" Isaacson said as they trudged up the steps of the decaying condominium. "By gum, I knew we'd get the heathen devils sooner or later."

"Actually, she may help with more than that." Tanaka stopped at the first-floor landing and looked soberly at Isaacson. "No farting around now, Dave: Lisa is a—a very close friend of mine, and I wouldn't suck her into anything unnecessarily."

Isaacson leaned against the banister and smiled. "Finally decided to trust me, eh, Tanaka?"

"What do you mean?"

"For crissake, Don. For the past two weeks you've been sounding me out like a Secret Service agent squinting in a dim light. I'm glad to hear I've got clearance with you, for whatever the hell you've got cooking."

"I—was I that obvious?"

"Only to a fellow paranoid. Don't sweat it. Come on, let's slink up to Miz Donerey's apartment and you can relieve yourself of all this cloak-and-dungeon dreck." They ascended the staircase until they reached an



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apartment on the third floor.

"Hello, Donald." Lisa Donerey greeted Tanaka with a warm hug and a lingering kiss. She was an attractive woman of about twenty-seven, dark-blonde hair falling to her shoulders. She had wide brown eyes that seemed to penetrate all they set upon; a thin smile tugged constantly at her lips. "Governor Isaacson. Pleased to meet you," she said, taking his hand.

"Dave, please, Ms. Donerey. I'm no longer Governor of anything, alas."

"Of course. And I'm Lisa." She showed the two men into the living room, serving up some instant coffee. Isaacson took a cup as she cocked her head to one side and said casually, "The prospect of being vice-president doesn't excite you, then?"

Isaacson blinked. "What, uh, gave you that idea?"

"It's true, isn't it?"

"Yes, but—"

"Donald hasn't told you about me?"

"Told me what?" Isaacson glanced at Tanaka, seated next to Lisa, his arm across her shoulders. "To borrow your own elegant phraseology, Don, no farting around. Are we doing something illegal? If so, give me a minute to call a lawyer. I'll have the Justice Department post bail."

Donald smiled. "Illegal, no. Heretic, maybe. Do you know what it's like to be a press secretary in this administration, Dave?"

"No, but I have a hunch you're going to tell me."

"It's tantamount to doing PR work for the CIA: grabbing at shadows. Cooper keeps me at arm's length, content to deal 'directly' with the public—through holovision, personal appearances, that sort of thing.

"I've got friends in the press corps—or at least I did; they all think I've turned renegade, become sort of high priest of obfuscation. They ask me if the stigmata are genuine, if Cooper is sincere—all off the record—and dammit, *I can't answer them!* I don't know where the bloody things come from, whether they're real or faked or—" There was a hurt tone to his voice as he added softly, "But they don't believe me, Dave. They don't believe me."

Isaacson shrugged. "You're not alone, Don; half the pols in town would like to know who or what is behind those stigmata. Hell, *I'd* like to know." He smiled crookedly. "But then you knew that before taking me here, didn't you?"

Tanaka nodded, embarrassed by his own subterfuge. "Yeah. Sorry, Dave, for feeling you up like that, but—before involving you I had to make sure you'd be willing to take the risks."

"Which are?"

Donald turned to Lisa. "Lisa holds an M.A. in parapsychology from MIT. Several years ago she took part in Leonard Cartstairs's experiment in group-consciousness. You've heard of it?"



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"Vaguely. Wasn't that the thing that resulted in the shutdown of the entire parapsych department?"

Lisa nodded. "Three people died, Dave. It was an exercise in group telepathy that became—misdirected. A lack of . . . 'circuit breakers', you could say—the personalities involved lost their psionic integrity—"

"Lisa was one of the few to escape whole and well," Donald said. "Those that didn't die, with the exception of Dr. Cartstairs, turned schizophrenic. All lost their positions."

Isaacson stared at the woman with new insight. He tried to guess the shape of the thoughts that ran behind those eyes, then with a start realized that she might be doing the same to him, with infinitely more success. *A telepath?* he thought, thrusting the word into the forefront of his consciousness.

Lisa smiled. "Yes. A telepath," she said.

Isaacson, at first startled, leaned back in his chair and clucked his tongue. "I'll be damned. And you think that you might be able to read Cooper's mind?"

"If I can be present the next time he has stigmatic communion," she said, "yes, perhaps I can; perhaps I can determine whether the contact is a holy or a hellish thing."

"Can you dig deeply enough, though?"

She studied him with that intense brown gaze, and Isaacson felt a sudden panic well up within him. He felt as if he were falling, stumbling into those eyes, into that tender, caring, knowing, merciless gaze . . .

"Deeply enough," she said softly. "Why do you work so hard at killing yourself, Governor? You take pills to speed you up, drink to slow you down, politics to keep you alive. Why do you need any of them?"

Isaacson fought back his terror. "I don't see—"

But she would not relent. "You want to kill yourself before—before *they* kill you. Don't you?" She nodded as if this were not surmise but fact, and of course it was. Of course. "They've killed all the good ones, all the decent ones: Lincoln, King, Calahan. But you won't be next. Oh, no. You'll beat them to it; you'll be dead before a shot is fired, won't you, *you'll* be your own executioner and no one else—no one else to share the legend, no Oswald or Booth or Bremer or—"

"*Shut your frigging mouth!*" His face hot with anger, Isaacson found himself on his feet, trembling with rage and frustration at the sounds of truth, wanting to kill that truth, kill it, kill it, kill—

Himself?

He shut his eyes, balling his hands into fists. He calmed. "Oh Jesus," he said, biting his lip. "I'm sorry—I . . ." He felt a hand on his shoulder, pushing him gently down into the chair once more. He surrendered, feeling his body go limp. He waited for the coiling-back of mind and muscle, but that tautness never came,



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and he marveled at his own relaxation. He opened his eyes.

Lisa's gaze was now gentle. She smiled: it was a good thing to see. "Deeply enough," she said. "I'm sorry."

Isaacson shook his head, feeling wonderfully drained. "Don't be." He reached for his coffee, took a few sips, and felt almost lonely for the touch of her thoughts.

*I'll get you in somehow, Lisa,* he thought, but not to himself. *Damned if I know how, but I will. I will.*

And felt her answer. *I'm doing this for Donald. My thanks, David. From both of us.*

Isaacson smiled and finished his coffee.

*June 17*

It did not take long for the Senate to approve his nomination; even less for the House. In the meantime Isaacson entertained himself by shaking off the Secret Service personnel assigned to protect him, buying off those he couldn't shake, spending those private moments with Donald and Lisa and growing to need those moments as a respite from the paces he was put through each day on the Hill and in the White House.

It was not a hard pace, just an ugly one: this city was ugly, its people worshipped gods of power that should have died in the Dark Ages, and Isaacson began to wonder if those Ages had ever lifted . . .

His inauguration was set for the 17th, in the east wing of the White House. The ceremony was closed to all but members of Congress and their families; Donald could not invite Lisa, nor, really, could Isaacson, at least not properly.

So he did it *im*properly, lifting a security clearance here, performing a bit of subtle forgery there, all carefully surreptitious—they all agreed that Isaacson could not afford to be linked with even so harmless a fishing expedition as this: should anything go wrong, Donald would take full brunt of the blame.

The morning of the 17th Isaacson found himself wending his way through a roomful of Senators and Representatives, a clamor of Congressional ass-kissing such as he had never seen before. The glare of the holo spots almost hid from him the figure of Lisa in the second row, Lisa who did not smile or nod as he passed, her expression one of studied casualness.

The White House staff stood assembled in a rough semicircle on the dais, waiting for the arrival of the commander-in-chief. Isaacson moved up beside Tanaka, keeping a charismatic smile turned to cameras and audience, his whisper audible only to Donald. "Is she close enough?"—careful not to look directly at Lisa.

"Close enough to make contact," Tanaka said. "As long as there's no interfering medium—holovision, radio—and they're within a few dozen meters of one another—"



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But he was interrupted by the sudden swell of music, the jingoistic strains of "Hail to the Chief," that caused all attention to go to the eastern door of the room, through which entered Cooper, looking humble and a bit uncomfortable with the pomp and ceremony. Isaacson watched him politely but impassively, his attention momentarily drawn to Lisa; she too was watching Cooper enter, but more intently than any save Donald and Isaacson realized, her brown eyes barely blinking, her thin lips pursed tightly together.

Isaacson felt a chill at the remembrance of her mind-probing; would Cooper notice the touch of her thoughts? Would he react? Here, Cooper was straitjacketed by the presence of cameras and Congressmembers; but what about later?

Moving behind the podium, Cooper hushed the audience; the applause trickled and died. "Good morning," he began, his tone soft, a bit nervous. "It is my pleasure to welcome you here today . . ."

Isaacson glanced at Lisa: her eyes were narrowing in concentration. The drone of Cooper's voice went on, turning, it seemed, into a fierce buzzing, a mad hum that penetrated to every level of Isaacson's consciousness, and then quite suddenly the buzz became a thought, and the thought a word:

*Contact!* And a moment later: *He's in communion; look.*

He looked down at Cooper's wrist, still awed by the strange caress of Lisa's thoughts, and saw that yes, the wound was visible, the bleeding had begun, and even beneath his socks it was obvious that his ankles were puffed and swollen. The head wounds were starting to appear, as well, the lacerations blossoming like roses on his brow, like roses . . .

"Repeat after me?" said the Chief Justice, and Isaacson put his hand on the Bible as in a dream, repeating mechanically the oath of office—"I, David Isaacson . . ."

The buzzing returned, forming new whispers in his brain:

*Some sort of transmission, but—*

*—something more. Symbiosis, maybe? Can't tell. Dammit. I'll try to block—see if I can intercept transmission.*

*No,* he shot at her, "to the best of my ability," *too dangerous, dammit!*

*We'll never get a better chance.*

End of contact. Isaacson completed his oath; amid the rounds of hearty applause he could hear the buzzing grow to new proportions, becoming a wall of psionic "static" so loud, so tangible, he had to fight to recall that only he and Lisa and Donald could "hear" it. As he turned to face the audience, Isaacson could see Lisa's face—pale, now, growing paler as she jammed the Otherwhere thoughts with her own—

Cooper turned and put a hand on Isaacson's shoulder. He faced the crowd. "It is a double pleasure for me to . . . to—"

He stopped in mid-sentence. His mouth gaped, his lids fell. The stigmata on his forehead grew pale and



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pink; he lost his balance and leaned onto Isaacson for support, bringing a hand up to his brow, searching. Secret Service guards grabbed at him, pulling him away from Isaacson. One of them went rushing toward the holocams in the back of the room.

*The jamming—it worked.* Lisa cried exuberantly. *I've intercepted them—they're—*

Mute horror crept into her tone: *Oh my God, no—no—Donald—David—they're trying to—*

*Break contact!* Isaacson shouted, his eyes burning with frustration. *For Christ's sake, Lisa, break contac—*

*I can't! I can't! I—*

"Mr. President! Mr. President!"

Lisa screamed.

The president crumpled like a wax dummy.

Tanaka ran for Lisa, Isaacson for Cooper. The newly-installed VP was shoved roughly away by the bodyguards, but not before he saw clearly the expression on the president's face: an idiot-look of complete simplemindedness . . . the empty gaze of the hopelessly insane.

The guards shuffled Cooper off the dais and out through a rear door. Isaacson turned back to find the room in turmoil. The President, they were screaming, oh Christ help the President, and above the din and clamor someone else was shouting that a woman had just died.

It was a murder of the mind, and only Isaacson knew or cared, now that Donald, too, was out of the fight (for that was how Isaacson thought of it, a fight, a holy war waged against nameless gods). The FBI easily managed to link Tanaka with the woman who had died of a brain hemorrhage at the same moment the President had had an attack of acute vertigo. Quoting now from the press releases, of course. There was no hard evidence connecting the two events, but Cooper would have been a complete fool to keep Tanaka on staff, and, inasmuch as Donald suffered something of a minor breakdown upon Lisa's death, there was a "legitimate" reason for his dismissal. It was just as well—part of Donald had died with Lisa, the anger in him had cooled and turned to bitter ash.

But Isaacson remained angry, and in fact that anger grew, nurtured by his memory of Lisa's screams and Donald's cries. The rage cooled, though, no less intense but tempered now by an icy determination to defeat or expose those forces that had killed his two closest friends. It was for them that he would fight, for them and not for "the good of the nation": people did not die out of love of country but love of self, family, ideals.

This was Lisa's war, and Donald's. But most of all Lisa's, for she had given the most and had cared the least, dying like a lost soldier in an odd, lonely cause.

Lisa's War began in earnest.

*November 12*

The dimly-lit room in the base-



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ment of the EOB was hot and dry; somewhere an air conditioner churned sluggishly, doing little more than recirculating the stale atmosphere. Isaacson coughed as he operated the holo projector, throwing onto the screen the gray flickering shadows of a cerebral X-ray . . . image after image of the brain of Lisa Donerey.

The brain looked terribly . . . *wrong*. The surface convolutions had been subtly altered, gyrus and sulcus not scarred but sculptured, as if some force had attempted to make contact with her mind by *changing* it—by creating a one-to-one correspondence that would have resulted in *one* mind in *two* brains . . .

"How did you get this?" Cartstairs asked nervously, flicking ash off his cigarette, squinting at the screen with revulsion and fascination.

"I bribed the right people," Isaacson said. "Cooper had the autopsy put under a seal of secrecy just two hours after it was completed. The price rose sharply, but not prohibitively. These are dupes; the originals are still safely locked up at Bethesda Naval."

"And your guards?" Cartstairs said, his quick yellow eyes glancing about the room, a nervous tic pulling at the corner of his mouth. "Is that how you got rid of them, too—through bribery?" His tone was not judgmental but curious, detached.

"No; I had to be somewhat subtler there. I—convinced them—to work with me. Not *for* me, *with* me. It took a few months to feel out just which ones would be able to accept the idea that the President of the United States was—insane. Then I showed them some bootleg holotape of my inauguration ceremonies—the stuff that never got on the air—including a few pointed shots of Cooper, cut off from whatever forces are controlling him. That clinched it. They're with me now."

Cartstairs licked his lips. "And you need me to do what—what Lisa did? To block off those forces once again?" He shook his head. "But where is the sense of it, Mr. Vice-President? Even if I could—*if*—I could only keep it up a brief time, briefer perhaps than Lisa did. Cooper would inexorably fall back under the domination of whomever controls him. And I," he added, "might very likely die."

"*We* might very likely die," Isaacson said. "Whoever is in control would surely realize that I am the force behind this attack; if you buckle under, I'm dead, too. But I hadn't planned on you alone to block them."

"Who, then?"

Isaacson snapped off the holo projector. "I think perhaps Professor Garfield and Dr. Bonis would be of assistance," he said quietly.

Cartstairs's eyes widened. He blinked. "John and Marcus? But surely you know, sir—they are—incarcerated. Severely schizophrenic, both of them. The experiment at NYU—it permanently upset their balance.



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They are both . . . psychotic."

"Not violently so," Isaacson said, holding up a pair of folders and sliding them across a table to Cartstairs. "One is suffering from catatonia, the other hebephrenia. And both—both remain telepathic to some extent, do they not?"

Cartstairs looked at the folders, touched them once, drew away his fingers and nodded. "Yes. It must be an awful thing for them . . . to see into others' minds, yes, but to have that gift only torture them . . ." He winced as if multiplying his own petty agonies a thousandfold.

"The four of us stand a better chance of success—and survival—than any of us alone. And if we do succeed, exposing Cooper for the puppet that he is—"

"You become President," Cartstairs said with absent cruelty.

Isaacson clenched his right hand into a fist. "The thought doesn't excite me, Doctor, I assure you. But if that's the only way to save the country—"

"But save it from what? The programs he has initiated are good ones, decent ones. He has shown no malice. He is a competent chief executive, you must admit that?"

"He is competent only when *they* make him so," Isaacson said. "Jesus, man, even if this is something as mundane as foreign manipulation, which I doubt—"

"What evil has he done? What harm?"

"He killed Lisa!" Isaacson snapped, slamming the fist into the table. "*They* killed Lisa. That's not Elwood Cooper in that oval office, dammit—it's an alien consciousness that doesn't hesitate to hemorrhage a woman's brain, or to wipe blank a man's mind and replace it with its own desires! Elwood Cooper—you want to see the real Elwood Cooper?"

Isaacson snapped on the projector. The holoscreen lit up once more, the tape of the inaugural ceremonies coming into slow focus. The swearing-in; the panic; the mad shuffling dance of security guards; and then a close-up of the President's face as they dragged him away from prying stares—

Isaacson froze the image: The blank, confused gaze of the village idiot stared out at them, a pathetic hunger in the eyes, a need for substance, for thought, for purpose and for faith . . .

Perhaps Cartstairs had seen that gaze before. He was silent a long moment, allowing his cigarette to burn down to the filter, smoke curling about his fingers as he watched the screen with narrowed eyes.

His voice, when he spoke, was soft. "I feel an anger within you," he said at last, not turning. "Deep anger, and love." He glanced at Isaacson. "Did you love Lisa?"

Isaacson felt empty, sick of the self-righteously patriotic tone he had thought to convince Cartstairs with. He discarded it. "She was a friend.



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She showed me parts of myself I never wanted to see; how could I not love her? Or Donald? And now they're—"

He did not finish. Cartstairs fell silent again, then nodded once and stood.

"If I must kill," he said quietly, "then let me kill for love. Eh? That almost makes it moral. Though not quite." He took Isaacson's hand and shook it. "If you can deliver John and Marcus from their institutional hells, and if they agree—you have my cooperation. All right?"

"Thank you."

"Thank Lisa. I knew her, too." He turned to go, but paused at the door, looking back with sad eyes. "But please—whatever the reasons for it, whatever excuses we make—do not forget that we are, in the end, killers. Eh?"

*December 10*

Another ceremony: the signing of a bill granting immunity from prosecution to reporters who refused to divulge their news sources. It had been a pet hope of Donald's, who had convinced Cooper to study the matter; Isaacson had wanted to follow up on it, but dared not associate himself too closely with Tanaka, even in retrospect. But Cooper had seen fit to endorse the bill without prodding—another decent move, damn it.

Armed with three bribed security clearances, Isaacson led Cartstairs, Garfield, and Bonis through the serene corridors of the White House. A handful of Isaacson's personal security guards, three men and a woman, followed them. Isaacson, feeling absurdly like a cartoon revolutionary, could not restrain his nervous glances at the two schizophrenics flanking him. Thus far they had been inconspicuously normal, but . . .

Garfield, the catatonic, walked mutely on, guided by the gentle hand of Cartstairs. He was a heavy-set man whose lids drooped not abnormally, who showed no sign of interest in the world around him or in his place in that world. In other words, Isaacson thought wryly, he looks not unlike a U.S. Senator.

Bonis, the hebephrenic, was a tougher nut to crack (I am definitely going to have to cut this out, Isaacson thought with a faint smile). Thin, bony, gaunt, Bonis was plagued by a set of private delusions and hallucinations, possessed of an array of bizarre gestures and mannerisms, and given to fits of giggling at unforeseen moments; when he spoke it was in short, fragmented sentences. (When asked to help, he put a finger to his lips, choked back a giggle: But of course I'll do it. Of course.)

This unlikely quartet, then, made their way to the Oval Office, entering to join half a dozen Senators and Congress members, a handful of Cooper's guards, and a holocam crew, all gathered to witness that stigmatic hand putting the kiss of God to paper.



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Isaacson placed a thought in the forefront of his consciousness, repeating it over and over until Cartstairs finally picked it up: *Leonard? How do you feel?*

Cartstairs replied, *Not calm but not desperate. I feel John tensing.* Isaacson looked at Garfield but could not see any noticeable difference in his demeanor; he took Cartstairs's word for it.

Bonis chimed in: *Silly John, always was tense. What's to fear? We're only here to kill a president.* And he giggled.

Isaacson's heart pounded, but thank God, no one noticed Bonis's chuckle. The vice-president moved away from his fellow conspirators, stood at a corner of Cooper's desk as Cartstairs led Garfield and Bonis behind a gaggle of Senators, out of sight of the holocams. Isaacson's guards positioned themselves throughout the room.

Cooper caught sight of Isaacson and smiled a hello. The very warmth of that smile pained Isaacson; he returned it, casually he hoped, his lips dry, his throat constricted. Oh God. Oh Jesus. What if it didn't go off? This benign madman, this merry old king with half a mind—and all that stands between him and Forever are three schizophrenic telepaths.

Bonis, again: "*The only thing to love is Fear itself,*" he quoted. *That's Plath. One of us, you know: crazy, so crazy.* A mental giggle. *That makes me a teleplath?*

Isaacson almost smiled; there was a caring in Bonis's tone, an attempt at soothing humor that was twisted but sincere. At least he cared enough to try. Was that the difference between the mad president and the mad Bonis? One cared, the other was *made* to care . . .

"I take pride in signing this bill into law," Cooper said into the white glare of the holos. "Since the 1960s these basic rights have been too long neglected—"

*Now!* snapped Isaacson.

The three minds joined—the soft undercurrent of thought which had murmured like a brook turned now into a swollen river of emotion. They reached out and grabbed at Cooper's brain, Isaacson listening in, the eternal observer. Even so, he could feel Cooper's shock at the sudden psionic pawing; with a determined effort, blocks slammed up to protect the empty mind from attack.

*Silly*, thought Bonis for all to hear, *we're not trying to get IN . . .*

Cooper began to realize just that: but too late. A curtain of madness sprang up around him, formed by the common insanity of Garfield, Bonis, and Cartstairs . . . for of course Cartstairs was mad; Isaacson had known that from the first moment he had seen him. The psionic babble flooded Isaacson's awareness.

". . . this . . . this bill . . ." Cooper halted. His hand went up to his forehead, though there had been no stigmata there, and Isaacson could see the wrist wounds fading,



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flickering, becoming as pale as Cooper's cold-sweating skin. He stammered. He blinked. ". . . I think that . . . I think--"

His guards began to rush forward, alert to the "vertigo," two to catch the wavering president, one to cut off holo transmission.

Isaacson glanced quickly at Garfield and Bonis. *The guards!*

The two men struck out with savage force to the minds of the Secret Servicemen rushing to Cooper's side, making instant and merciless *contact*: their insanity streamed forth, pouring into the helpless minds of the two guards.

One turned abruptly inert, engulfed by the waxy horror of catatonia. He dropped to the floor like a legless doll.

The other screamed as delusion washed over his awareness, hallucinations blooming like black orchids in the garden of his reason, and he went toppling into the president's desk, arms flailing wildly.

The third one quickly forgot the holocam and came rushing back to assist his friends. He was joined by Isaacson's guards, who smoothly pulled syringes from their pockets, shot 12 cc's of Darvon into the two suddenly-insane guards, and, for good measure, into the third man, as well.

No one noticed the miscalculation. The room was in an uproar at the sight of the spasmodic president, his crown of unseen thorns fading in-again, out-again, his eyes first blank, then startled, then hurt . . .

*Put up the wall!* Isaacson rushed to the president's side. "Back, please, stay back," he told the legislators, checking Cooper's pulse with false concern, noting with mixed emotions the stigmata fading, fading, reduced to pink scars by the psionic force-field surrounding them.

And then suddenly, Cartstairs, his face pale, leaning against a wall, body atremble: *Oh Christ, David, look out--they want* you, *they won't--too strong, too terribly--*

Isaacson felt something clutch his brain in an icy grip, felt himself thrust into a void between the stars--far distant he heard Bonis, his voice a singsong, repeating, *The only thing to love is--*

Time dilates:

Isaacson *knows*, wordlessly, that they are in his mind--fingering his brain, now, molding it even as they sought to alter Lisa's. No. No. Don't let them. Let them mold only words, not ideas, not the basic emotions that would engulf him as they had engulfed Cooper--

*Who are you?* Isaacson demands, fighting. *God? Aliens? Both?*

*Do you care?* Isaacson answers himself. *You would kill Us in either case.*

*Or cast you out, yes*, Isaacson admits.

*Why? Because of him--because of her? All regrets; there was no intent to kill. We needed to defend.*

*You control. You manipulate.*



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*We counsel, We protect.*

*Your time is past!* Isaacson shouts at himself, and perhaps he has argued this before. *Humanity has no need for gods.*

*No?* Isaacson mocks himself with brief images of war, famine, butchery, the cruelties of love, the futility of fear.

*No!* Isaacson screams with passion, and in that passion stumbles over his words: *If–if we* must *die, let us die by our own hands, fools to the end. But if we live, if we love . . . let that be by our hands, too! Else–why live? why love?*

Silence. Isaacson presses home his point, savagely, pointedly:

*We stopped you once. And needed thorns to do it. Don't make us. Please. Not again.*

Silence, again; a mute hope, an awful panic; and then the Other Isaacson, in a sad and lonely 'voice', in a tone very much like a sigh:

*The memory is too fresh. We will go.*

Adding, *And you are the next mad king.*

Time irised open and flowed once more:

Isaacson, bent over the desk, looked down at Cooper below him. The president stared up at him with empty eyes, a vacant, bemused expression on his face. Isaacson turned quickly away, confronting the chaos around him.

More guards were tumbling into the Oval Office, rushing to aid their drained, pathetic president. The holocams had moved in and were dwelling lovingly on Cooper's hollow gaze, on the spittle running down his chin. There would be no doubt left in the public mind . . .

Cartstairs looked up, slumped against the east wall, nodding once to Isaacson: he appeared whole. As did Garfield and Bonis–in fact, too whole: Garfield's waxy stance had turned firm and erect. Bonis's wild giggle had ceased . . . The shock of the mind-link? or Their last gift to humanity?

Isaacson fought his irritation at that gift, wondering for a moment if his anger was a wholly rational one–wondering with horror if his actions had been wholly rational.

The mad king of America. My God, he thought–am I, am I really?

But there was no one to answer him, no one at all. ■

## in times to come

When we get enough people and machinery into orbit around the Earth we will open a new Industrial Revolution and utterly transform life on our home world. Agreed. But what about the human side of it? How will people *live* in space? Spider Robinson's novella, "Stardance," looks at this in a fresh and compelling way in next month's issue. We will also have a science fact article by Alfred Bester on gourmet cooking in space, plus stories by James Gunn, Christopher Anvil and others, as well as our regular features.

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# the reference library

LESTER DEL REY

**DEADLINE AND DEARTH:** Long before I had a regular column on books, I was an avid reader of book reviews. Sometimes I read the editorial first, but the reviews were always scanned before I looked over the stories.

Yeah, I know—writers are supposed to do things like that, looking for what someone has to say about their latest books. But in my case, this had little to do with it. I never wrote many adult science fiction novels, so the chance of finding myself mentioned was rather remote. It was just an example of some mild compulsion or habit, probably.

Anyhow, there was one thing that always annoyed me about many of the reviews I read. That was the fact that in most cases, the review appeared anywhere from a month to two years after the book being discussed was off sale. At the time this annoyance became most obvious, I was living in a small town where the bookstore didn't keep books on the shelves very long. But even when I got into New York City and had time to go to a better bookstore, the chance of finding any given book that had sounded interesting was not enough to make it worth looking.

I assume that the same trouble must have bothered other readers. Of course, today, for the fan living in one of the larger cities, things have changed. There are now stores specializing in science fiction where books are not automatically returned to the distributor after the normal short on-sale period. There a book may be found as long as the publisher has any in print—and sometimes long after. But what about the fan who doesn't live near such a store? To him, I suspect a review of an unavailable book must be as frustrating as it used to be to me.

There are excellent excuses for the delay between publication and review. Editors naturally like to have their columns in well ahead of deadline—and preferably, to have at least one extra month's column in advance, in case anything goes wrong. Review copies, which should be sent out long before publication, often precede the regular books by only a short time. And for the reviewer, it must be nice to let the books pile up and do several columns at a time.

Nevertheless, when I began doing a regular column, I determined to do everything possible to see that the reviews appeared while the books were still on sale. That meant imposing on the editor to let me do the column at the last possible moment before his absolute deadline for sending all copy to the printer. And since there is an inevitable lag between copy going in and finished magazines appearing on the stands, even that wasn't ideal. When I could,



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I persuaded publishers to send me the galleys of the stories before the books were made up. These long galleys of unpaginated type are less convenient to read, but they assured me of immediacy in the reviews. (DAW Books gets my special thanks for sending me galleys and cover proof on every book!)

Maybe there are times when you still can't find a book I've recommended (assuming such recommendation encourages you to look for it), but I try to keep current.

There is some risk in such a policy. There are times when it is hard to find enough material in any given month to make what I hope is an interesting review column. There is also the risk that some months will have so many good books that they can't all be reviewed. (However, that has never happened yet!)

This time, the crop of books sent me was not a promising one. In fact, the deadline I'm supposed to meet came, and I didn't have a single new book that I thought deserved an honest recommendation.

Well, once upon a time John Campbell told me about a month when he looked over a lackluster pile of submissions and finally went in to his superior to ask what was to be done when an editor didn't have material to fill a magazine. Quoth the superior: "You find it!"

So I found it. This time, I'm reviewing the book from a photocopy of the copyedited manuscript, which is about as far back down the line from the finished book to the first step as one can get. Sorry, but I don't have the price—which will be in the medium-high range for hardcover books; I also don't have the number of pages—but it's a nicely long book. However, it should be available about the time this column appears in print.

The book is **Gateway,** by Frederik Pohl (St. Martin's Press). Pohl has indicated that he feels this is his best book to date, and I agree with him. It's also a rather oddly-told book. The main chapters tell the basic story, but there are minor chapters in between which fill in and enrich the story from the view of the first-person narrator Broadhead long after the main story is over. And there are also what Pohl calls "sidebars," inserts that give background and filler material which adds to the story. These can be skipped by the casual reader, though they add considerably to a full understanding. Trying to work this directly into the story would have made for much awkward construction. I think this is one experiment in the technique of telling a story which works—at least for this novel.

Basically, the novel deals with a situation and a character. The situation is one that carries a good, unstrained suspense element. When men first explored Venus, they found that another and more advanced race had been there half a million or so years before and had left bits of mostly undecipherable technology behind them. One such bit was a ship. The man who discovered this got it working—and was carried to an asteroid later named Gateway. The asteroid was all hollowed out, and there were almost a thousand faster-than-light "Heechee" ships still docked, though the Heechee had



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long since disappeared.

Those ships still worked—or most of them did. Nobody could figure out how they were fueled or how they operated. But they could carry one man—or three men or five, depending on the ship model—to another place in the universe. Trouble was, nobody knew how they were guided. Once set so a certain indicator-light brightened, they would go out—maybe to a nice planet, maybe to the atmosphere of a star—and then automatically return to Gateway when another button was pushed.

Broadhead was one of the prospectors trained to ride out in such ships. He had to go out; the cost of staying on Gateway was so high that he could only survive by taking trips out—and his only hope of getting back to Earth with enough to live on was to strike it rich on some alien planet. However, as his instructor told him, fifteen percent of the ships never returned; and four out of five came back with nobody on them alive. The chances of a successful trip were low—and Broadhead was not the bravest of men.

There is also the story of others—a couple of women who are fellow prospectors and who become involved with Broadhead, as well as Shicky Bakin, a man who has lost his legs on a trip and now gets about in the station on wings.

There is action, color, background and character enough in this novel to satisfy almost any taste, I should think. And the chapters which develop the later Broadhead contribute consistently to the advancing of the main story.

This is a damned fine novel and should be one of the contenders for the Nebula and Hugo awards.

**Walkers on the Sky,** by David J. Lake (DAW Books, $1.25, 192 pp.), also has some extremely good background material. It involves a world which has been settled after Earth could no longer be inhabited by man. Melior, however, is a rather small planet, not quite capable of holding sufficient atmosphere for life. To give it an atmosphere, certain unusual tricks had to be accomplished.

Some kind of force field was invented which would hold the atmosphere in. But to succeed, there had to be three such shells of force, one inside the other, with decreasing pressures.

Each of these shells was strong enough to hold the weight of a man walking on it, though it could be pierced by a sharp object. The action begins on the world above the first shell. There they even have ships that can sail across the shell, supported in the "sky" by the strength of the shell. Below that is another world, based on the surface of the planet itself. And above is a world which has been taken over by the "gods"—the original men to shape the planet, now immortal.

It should have made for some interesting developments, and there are touches. But unfortunately, Lake has used this excellent background to turn out something like a routine sword-and-planet story. There is the young warrior hero, armed with his code of honor and his sword, who seeks adventure on one of the sky ships. He gets sold as a slave to a



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bunch of sky nomad raiders. He escapes and becomes first a house-carl and then the trusted friend of a prince. When the prince is betrayed, he again escapes.

This time he falls through the sky to the lower level. And there he naturally begins a revolution that is to free all slaves, win him glory, protect the lower world's people, restore the prince, and so on. You can fill in the details. Some use is made of the peculiar nature of Melior in the various battles, but only as a means of winning another revolution.

It's not a bad book. The writing is adequate and the story serves to pass time well enough. But at best, what should have been a fine idea is turned into a routine adventure novel. Too bad.

Oddly, the hero of **Star Wars,** by George Lucas (Ballantine, $1.50, 224 pp.), is named Luke Skywalker; however, there is no other relation to the previously-reviewed novel, and Luke doesn't literally walk on the sky.

This was a book for which I had considerable hopes. At the recent SF Worldcon in Kansas City, there was a splendid display of the special effects of what may be the most important sf movie of 1977, which is to be made from this book. Some of the artwork of scenes from the movie were marvelous.

Unfortunately, the book doesn't live up to expectations—which may have been a bit too high, I admit. The plot is rather like a mixture of a Heinlein juvenile and a novel about Captain Future from an earlier day. Luke, the eighteen-year-old hero, is a boy who grows up on a backward planet of a decaying stellar Empire. He wants to go to the space academy and become a great hero, like his father. But his hopes seemed doomed until a ship of rebels against the Empire is destroyed in the skies over his home. Then a small robot who has escaped from the bevel ship leads him to old Ben Kenobi, who turns out to be the legendary rebel leader, Obi-Wan Kenobi.

When Luke's home is destroyed by Empire forces searching for the robot, Luke gets his chance to go off to fight under Kenobi. (The little robot carries secret information the rebels need against a great fortress—a mobile planetoid—which is about to destroy the rebel world of Alderaan. That information was planted by a princess of Alderaan.) And Luke is caught up in the need to free the princess, then to help protect the rebels against the evil Dark Lord who is leading the corrupt forces of Empire.

There's plenty of action. Maybe too much action for a good novel. There's no room left for filling in the color and feel of the background, nor for developing the characters properly. We have to fall back on the simplistic good guys and evil men. The best character in the book is Kenobi—but he is reduced to a mere whisper at the end.

Most of the plotting is routine and very old-fashioned. And I'm a little puzzled at some of the science. I can't quite figure out how fighting ships in space can turn, circle, and dart about like fighter planes of World War II, when they're out in



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space. I thought Newton's laws still were enforced; there's no mention of their repeal in the book. Maybe the book is all right for some of the juvenile audience, but it certainly isn't for sophisticated readers.

I'm still going to see the movie when it's released, however; the story should play much better than it reads, and those special effects should be spectacular!

In the non-fiction section, Sam Moskowitz has **Strange Horizons** (Scribner's, $8.95, 298 pp.) This covers the history of science fiction in its dealing with the social predictions of the writers. Religion, racism, woman's rights, crime, war and even art are dealt with.

The articles on which the book is based originally appeared in various science fiction magazines, but Moskowitz has expanded them greatly, with a lot of new research. It's now a detailed study of the significance of early science fiction. With its complete index, it should be a fine reference book.

If the level of original science fiction (with the exception of Pohl's novel) is somewhat lackluster this time, some of the reissues and reprints help to make up for it.

Ace Books is beginning to bring out more works from the publisher's extensive backlist, and the recent ones have shown good judgment in their selection. Two are worth mention this time.

**The Blind Spot,** by Austin Hall and Homer Eon Flint ($1.75, 346 pp.), is one of the classics from the old Munsey days. It's either the first major story to deal with travel between alternate universes or one of the most powerful novels of strange occult powers beyond the normal ken of man, depending on how you choose to read it.

And **The Variable Man,** by Philip K. Dick ($1.50, 312 pp.) should be a revelation to Dick fans on how the author handled the more standard type of science fiction when he was just beginning. The stories stand up well indeed. "The Variable Man"—the title story, which is really a short novel—is one of my favorites still, though I had to read it repeatedly at one time. I'm delighted to have this copy to replace a well-worn one that was destroyed.

**PATENT LIST** Devices That Convert Rotary Motion Into Unidirectional Motion

| Patent No. | Nationality | Classification Class/subclass | Inventor | Date |
|---|---|---|---|---|
| 63188 | Swiss | 74/84s | Neimann | Sept. 1912 |
| 1,953,964 | U. S. | 74/84s | I. B. Laskowitz | Apr. 1934 |
| 2,009,780 | U. S. | 74/84s | I. B. Laskowitz | July 1935 |
| 2,350,248 | U. S. | 74/61 | A. C. Nowlin | May 1944 |
| 933,483 | French | 74/84s | M. Paillet | Apr. 1948 |
| 822,979 | German | 74/61 | H. Lorenz | Nov. 1951 |
| 770,565 | British | 74/87 | A. Reid | Mar. 1957 |
| 573,912 | Italian | 74/84s | Trivellin | Mar. 1958 |
| 2,886,976 | U. S. | 74/112 | N. L. Dean | May 1959 |
| 1,409,595 | German | 74/61 | M. Losenhausen | Oct. 1968 |
| 3,555,915 | U. S. | 74/84 | H. W. Young | Jan. 1971 |
| 3,584,515 | U. S. | 74/84 | L. B. Matyas | June 1971 |
| 3,653,269 | U. S. | 74/84 | R. E. Foster | Apr. 1972 |
| 3,968,700 | U. S. | 74/84s | C. I. Cuff | July 1976 |



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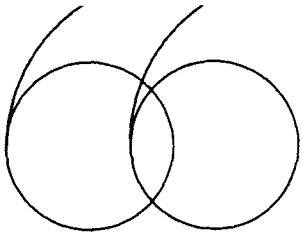
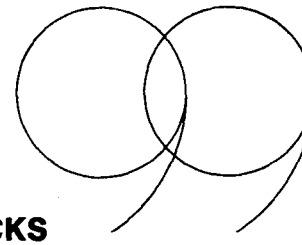


## BRASS TACKS



Dear Ben:

After reading the Brass Tacks department in the September edition, I was amazed that, seventeen years after Dean received his patent, there are so many people still trying to figure out how it works. Let me add my two cents worth.

There are only two ways of varying the centrifugal force which is produced by a gyrating mass:

1) by varying the angular velocity of the gyrating mass;

2) by varying the radius of the gyration, and thus the linear or peripheral velocity, of the gyrating mass.

Dean's device obviously uses the second method. If Dean's device can actually produce an unbalanced force which acts in one direction, then obviously the gyrating masses must receive a greater displacement in one direction than they receive in the opposite direction. To accomplish that, all Dean has to do is to use springs having different elastic constants. In other words, the springs which are attached to the top of the vibrating member are different from those which are attached to the bottom of the vibrating member.

Another thing that has to be taken into consideration is the natural resonant frequency of the vibrating system. The natural resonant frequency of Dean's device could be determined by simply pushing the vibrating member or system to one of its limits (with the motor unenergized) and releasing it. It will vibrate at its natural resonant frequency. Now if the period of one revolution of the eccentric masses is equal to the period of the natural resonant frequency of the vibrating system, then the impulses which are produced by the eccentric masses will be synchronized (in phase) with the displacement of the vibrating member or system and the restoring forces of that system. In other words, when the vibrating member reaches the highest position the eccentric masses will be directed straight up and when the vibrating member reaches its lowest



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position the eccentric masses will be directed straight down.

But if the period of one revolution of the eccentric masses is not equal to the period of the natural resonant frequency of the vibrating member or system, then the impulses which are produced by the eccentric masses will no longer be in phase with the restoring forces of the system which are produced by the compressed and stretched springs. Thus the magnitude of the resultant force at any given moment is determined by the angular position and velocity of the eccentric masses, the momentum of the vibrating system, and the force of gravity if the system vibrates in a vertical plane.

I am enclosing a partial list of patents (see p. 170) that have been granted for "reactionless drives." Maybe you and/or some Analog readers would like to study other devices besides Dean's. . . .

CALVIN I. CUFF

Brooklyn, N.Y.

*Thanks for the analysis and the patent information. But none of these devices, including your own, actually produce unidirectional motion, do they?*

Dear Mr. Bova:

A few comments and additions to Mr. Spinrad's article on space colonization are in order.

Concerning the Transport Linear Accelerator. While such a device has never been built as a catapult, several electromagnetic transportation prototypes *have* been developed that incorporate the *basic* technology that would be used in the TLA. The present design envisioned for the TLA uses an aluminum track with super conduction buckets arranged in a "null-flux" pattern that is highly stable. (See "Electromagnetic Flight" in *Scientific American*, October 1973.) A steering system incorporating high-powered lasers some distance away from the accelerator has also been envisioned for giving the system the "diabolical" accuracy required. Indeed, the greatest problem seems to be how to keep the track rigid. (A quick calculation shows that the difference between a straight line—the track—and the moon's curved surface over a distance of eleven miles is well over 300 feet!)

Mr. Spinrad mentioned that the entire reason for building the colony at L5 was because of the supply problems from the Moon. This is incorrect. While the logistics problem is definitely *one* of the considerations, much more important is the question of stability. If the colony were placed in, say, geosynchronous orbit, gravitional forces would eventually perturb it out of that orbit. L5, on the other hand, is a potential minimum in the Earth-moon system—a certain amount of energy must be expended just to get something to drift away from it. This is obviously very important for a colony that is expected to remain operational indefinitely. An alternative site for the colony would be a recently discovered resonant orbit about the entire Earth-moon system, which proves to be highly stable.

Stability is also the major problem in the mass-catcher system. If it is located at one of the Lagrange points bracketing the moon (as is planned at this time), it will have to expend



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energy (and more importantly, mass) to conserve momentum, since these points are potential *maxima*. Several solutions to this problem have been offered, but none seem very attractive.

Finally, a few words about the colony itself. Last summer the NASA-Ames Summer Study (held at Stanford) discussed the colonization issue. It eventually abandoned O'Neill's cylindrical structure in favor of a toroidal one 900 meters in radius. There were several reasons for this. One is that structurally, the entire hull of a toroidal colony would be in tension, with no major stress points. There is also a medical reason: there is evidence that rotational speeds over 1 rpm affect human balance adversely. With O'Neill's 100 meter radius cylinders, the angular velocity would have to be almost 3 rpm to maintain a one-g acceleration.

The external farming pods were also abandoned, due to the destructive effects that cosmic radiation would have on the crops.

As a matter of fact, all of the technical problems Spinrad outlined seem rather inconsequential when compared with the shielding problem. An unprotected colony in space would receive disastrously high amounts of cosmic radiation within a matter of a year or so.

Shielding solutions fall into two major categories: passive, where the goal is to simply absorb the radiation, along with any secondaries generated, as well, and active shielding, where particles are actually repelled or diverted away from the colony. Passive shielding for a space colony would probably consist of lunar slag cemented around the colony to a depth of several meters. The colony would have to be lighted by means of a large mirror that would reflect light down into the hub of the torus, and from there through a system of reflecting "chevrons" designed to let light into the colony but keep cosmic radiation out. The problem with this type of shielding is that, because of its low tensile strength, the shield cannot rotate, while the colony inside the shield must.

Active shielding, while technologically impossible *today*, looks much more promising in the long run. Cosmic radiation could be actively diverted in a number of ways. The most exciting, and quite possibly the most promising, as well, is the plasma shield. This approach (developed at Avco Everett, incidentally) requires only a small magnetic field to be put around the hull. Electrons from the hull are then injected into this field (a small betatron will accomplish this nicely) and trapped there, allow positive charge to leak off of the hull at only a very slow rate. The high positive potential on the hull should be capable of repelling most cosmic radiation.

RANDALL BAIRD
372 Memorial Drive
Cambridge, MA 02139

*The main problem with the O'Neill L5 concept is that it has been put forward in the kind of overly-simplified and overly-optimistic way that in the past has earned science fiction enthusiasts the epithets of "naive" and "brash." We need bold ideas and creative thinking in our space planning. But no*



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*idea should be accepted uncritically.*

Dear Mr. Bova:

I have been following the serialization of "Minotaur in a Mushroom Maze" with great interest; I found it well-written and excitingly paced. However, the concluding installment disappointed me.

It may (or may not) surprise you to learn that there are people in today's world who do in fact worship the Earth Mother Goddess, although not necessarily with the rituals of ancient Crete. And not all of these people are far-out "nut cult" types; some even read Analog. There may even be some people who might applaud a return to the matriarchal socio-religious system of Minoan times. (These viewpoints, of course, overlap somewhat.) But even the most zealous Goddess-worshippers and/or matriarchalists) don't intend to blow anybody up to prove their point!

I don't think that the Corrigans (or you, Mr. Bova) consciously meant to defame anyone's religious practices. But it is possible that someone who is both a worshipper of the Great Goddess and a reader of Analog could take offense. Daydala Pandarou, and her fanatical violence (and the comments other characters make about it) are as much of a religious slur as would be a Jewish character depicted as a chronic business cheat. All religious beliefs deserve respect, no matter how ancient their practices, no matter how few their devotees. I hope that in the future there will be no more instances of this type of disrespect in the pages of Analog—even if it's unintentional.

Other than that, it was a damn good story!

ALICE MARIE STEWART
2830 Briggs Avenue
Bronx, NY 10458

*The Corrigans weren't defaming Earth Goddess worshippers, any more than newspaper accounts of the heinous killings performed by Irish Catholic, Arab Moslem, or Japanese Buddhist terrorists are denigrating those religions.*

Dear Ben:

Norman Spinrad's article in the July Analog is the best summary that has been published to date on the space colonization concepts and related proposals of Gerard K. O'Neill. With penetrating insight, Spinrad gets to the heart of the matter—in the foreseeable future. Congress is sim-

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ply not going to commit itself to a single space program that will require $8 billion a year for 2 or 3 decades. Knowledgeable experts agree that thermonuclear fusion plants can probably be developed for a fraction of that cost, providing humanity with an ideal source of energy. And there are economic/technological uncertainties besides the ones mentioned in Spinrad's article that make it extremely unlikely that space colonies can solve the Earth's population problems. For example, building a huge space colony in which all the atmospheric gases are completely contained would be an exceedingly difficult engineering task. If gas leak rates were similar to those in contemporary spacecraft, then oxygen and nitrogen resupply would significantly alter the economic parameters of the entire concept as viewed as a Malthusian crisis panacea.

O'Neill is to be given credit for stimulating renewed interest in space activities at a time when certain influencial sectors of the public were "turned off" or even hostile to extraterrestrial ventures. Focusing attention on a single space concept of such dubious feasibility that it can not be funded, however, could prove to be disastrous for astronautics in the long run. If all of the TV and other media publicity, efforts of L-5 Societies and similar lay support could instead be directed towards the early realization of the goals described in G. Harry Stine's *The Third Industrial Revolution* (Putnam 1975)—summarized in the January and February 1973 issues of Analog—then we might witness an astronautics renaissance that would solve most of our pollution and resource supply problems.

Stine's grand design is a pragmatic step-by-step program that would only require about $2 billion a year in additional NASA funding for 15 years. After that the products of his [Stine's] Phase One year-orbit space industrialization would make it self-supporting and would, in turn, pay for the subsequent lunar development and asteroid mining phases, etc. With adequate media coverage, the Third I.R. program could be sold to Congress within the next 2 or 3 years. Practical experience gained in the lunar development phase of the Third I.R. would then allow us to determine what type of space colonization might be possible in the future.

The Third Industrial Revolution combined with a successful program controlling population growth would allow humanity to create a utopian civilization in the Solar System. But that alternate future may not be realized without adequate funding for basic and applied science (astronautics included) . . . A small boy must crawl and then walk before he can run. He does not break the four minute mile the first time he struggles to his feet.

ROBERT W. PREHODA
P.O. Box 2402
Toluca Lake Station
North Hollywood, CA 91602

*It's time to turn space operations into profit-making ventures?*

Dear Ben:

I am led to write this from having read Norman Spinrad's article, "Space Colonization Now: Vision



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and Reality", in the July Analog. For the most part, this letter is written not as rebuttal, but to express a different point of view. Norm Spinrad's article reflects the views of one who has read a few articles on this subject, or who has talked briefly with a few people, before sitting down to write. Thus, it may be valuable to consider the views of one who has been deeply involved in space colonization studies since early 1975, who has maintained close relations with the space colonization community, and who has actively participated in defining and solving critical problems.

At a number of places in his article, Spinrad appears to take exception to our proposed technical approaches. Rather than rebut him, I will simply note that these technical matters are treated rather completely in the technical literature. The interested reader is welcome to consult this work (for example, T. A. Heppenheimer and Mark Hopkins, "Initial Space Colonization: Concepts and R&D Aims", *Astronautics and Aeronautics*, March 1976). He then can judge for himself whether our proposals are indeed, in Spinrad's word's, "jury-rigged," "knocked together," or of "dubious" credibility. It is ironic, however, that such adjectives should be applied to such a straightforward concept as, for example, a launch vehicle designed as a modification of existing rocket systems. The irony is that Analog often has written blithely of fusion power, interstellar flight, and the like.

On one point, however, I must take issue with Spinrad. This is his apparent assertion that it is irrelevant to regard the space colonies as centers for the construction of power satellites, but that the colonies should rather be regarded from the start as springboards for humanity's settlement of the space frontier.

I confess to a certain sympathy for this viewpoint. I too am excited at the prospects of large-scale human settlement in space. But it appears irresponsible to overlook the large contributions which space colonization offers to one of our most pressing problems—the need for a cheap, nonpolluting, inexhaustible energy source. Solar power satellites, built in space colonies, show great promise as the solution of this problem. In addition, such powersats can offer the economic return which will make space colonization a paying proposition. In this connection, let us recall that the English backers of American colonization, four centuries ago, were certainly excited by the prospects they saw. But they also expected to receive their dividends from the East India Company.

Overall, it appears that space colonization, in its technical and economic aspects, is not a matter of science fiction. Rather, it lies within the province of advanced engineering development. It rests upon well-understood technical principles and existing engineering designs. It has already attracted the support of such political leaders as Congressman Morris Udall and Senator Barry Goldwater; and it may soon become a matter for national policy.

However, the social and societal aspects are less clear, and represent an area in which sf can make a definite contribution. From the start,



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space colonization advocates have appreciated that the contributions of sociology or anthropology would be as important as the contributions of the systems designers; and specialists in these disciplines have played major roles in the studies to date. However, perhaps we have been unlucky, or perhaps it is the nature of these disciplines, but we have been rather disappointed in the social studies we have received thus far. The social scientists we have consulted seem to have been hung up on their ideals of the perfect society, or have been led astray by their perceived opportunities to do social engineering. In any case, perhaps what is really needed is the viewpoint of the sf writer.

T. A. HEPPENHEIMER
11040 Blue Allium Avenue
Fountain Valley, CA 92708

*Spinrad's article* was *the viewpoint of a science fiction writer! There's a large and constantly-growing body of literature in SF that deals with isolated colonies. However, to assume that the space colonization proposal espoused by O'Neill* et al. *is foolproof would be sanguine indeed. This Editor worked on the Vanguard Project, which was touted by its sponsors as nothing more than "a modification of existing rocket systems." Remember the results of that canard? And just how "nonpolluting" would large-scale microwave energy transmission be? There are no valid data! What will the climatic effects be? The long-range health effects? And what will be the effect on the entire space colonization concept if (or when) less complex solutions to the energy problem are tried, and the solar power satellites never get off the drawing board?*

Dear Sir:

Please add to Dr. Hudson's list of cities converting solid waste to power Nashville, Tennessee. I have been involved with the Nashville Thermal Transfer plant in a very peripheral way (I work for an insurance rating bureau, and we've been working with Thermal and its insurance carrier to develop a fire protection system), and I have seen close-up some of the problems Thermal has had to overcome. Not the least of which is air pollution. Garbage makes a surprisingly good fuel. Sometimes too good, as occasionally water or wet garbage has to be mixed with the drier material to get an optimum BTU per pound ratio. One of the bad things is that garbage is not a clean fuel, as natural gas is clean, and the wet scrubbers installed to clean the stack gases were not entirely successful. As a result, a new, electrostatic precipitator system is now being installed at great expense. That, coupled with the fact that Thermal has had to burn fuel oil at some times owing to the necessity of meeting air quality standards, has put Thermal in a bad financial situation, and metropolitan Nashville has to subsidize Thermal through the device of a dumping fee. Still, Thermal's record is not bad—it was one of the first such projects in the United States, if not the first, and the engineers know more now than when Thermal started.

The Nashville Thermal Transfer plant serves basically as a central heating and cooling plant for downtown Nashville. Steam from refuse-fired boilers is used to heat in winter,



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or drive steam-powered chilled water cooling in summer, and even turns generators. I believe that except for refuse from the city and cooling water from the Cumberland River, the plant is self-sustaining. It is as much a pilot-plant as anything else, now. I hope it serves as a model for other cities. I've learned that the Japanese are making considerable progress along the lines of converting refuse into useful products instead of burying it or dumping it at sea, Tokyo already has one of the most sophisticated (and clean) municipal incinerator systems in the world, and they soon will have the most effective refuse-fueled power system.

WILLIAM R. HAMBLEN
946 Evans Road
Nashville, TN 37204

*A complete economic analysis of such a system would include the savings accrued from not having to purchase new landfill acreage, as well as the lung disease cases caused by the plant's pollution emissions. Will conventional bookkeeping give a fair picture of the public's profits and losses?*

Dear Ben:

The Nigerians may have hit upon the solution to our postal problems. According to news sources, mail deliverers in many semirural areas of Nigeria regularly chant "I've got an important letter, it's hot, it's burning me! It's burning me! Make way! Make way!" as they run along rural roads. Now, if only we could instill that kind of dedication in our postal workers!

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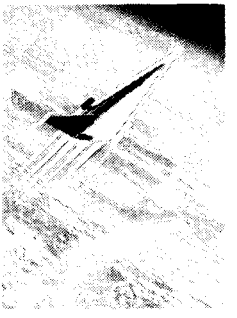

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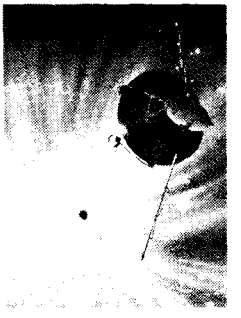

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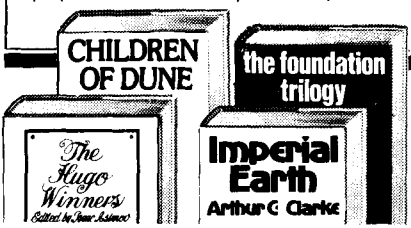


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